IGHT, JUNE 9, 1938

FIRST AERO WEEKLY IN THE WORLD

REGD. AT THE G.P.O. AS A NEWSPAPER

JUN 22 1938

FLIGHT

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The AIRCRAFT ENGINEER AND AIRSHIPS

OFFICIAL ORGAN OF THE ROYAL AERO CLUB

No. 1537
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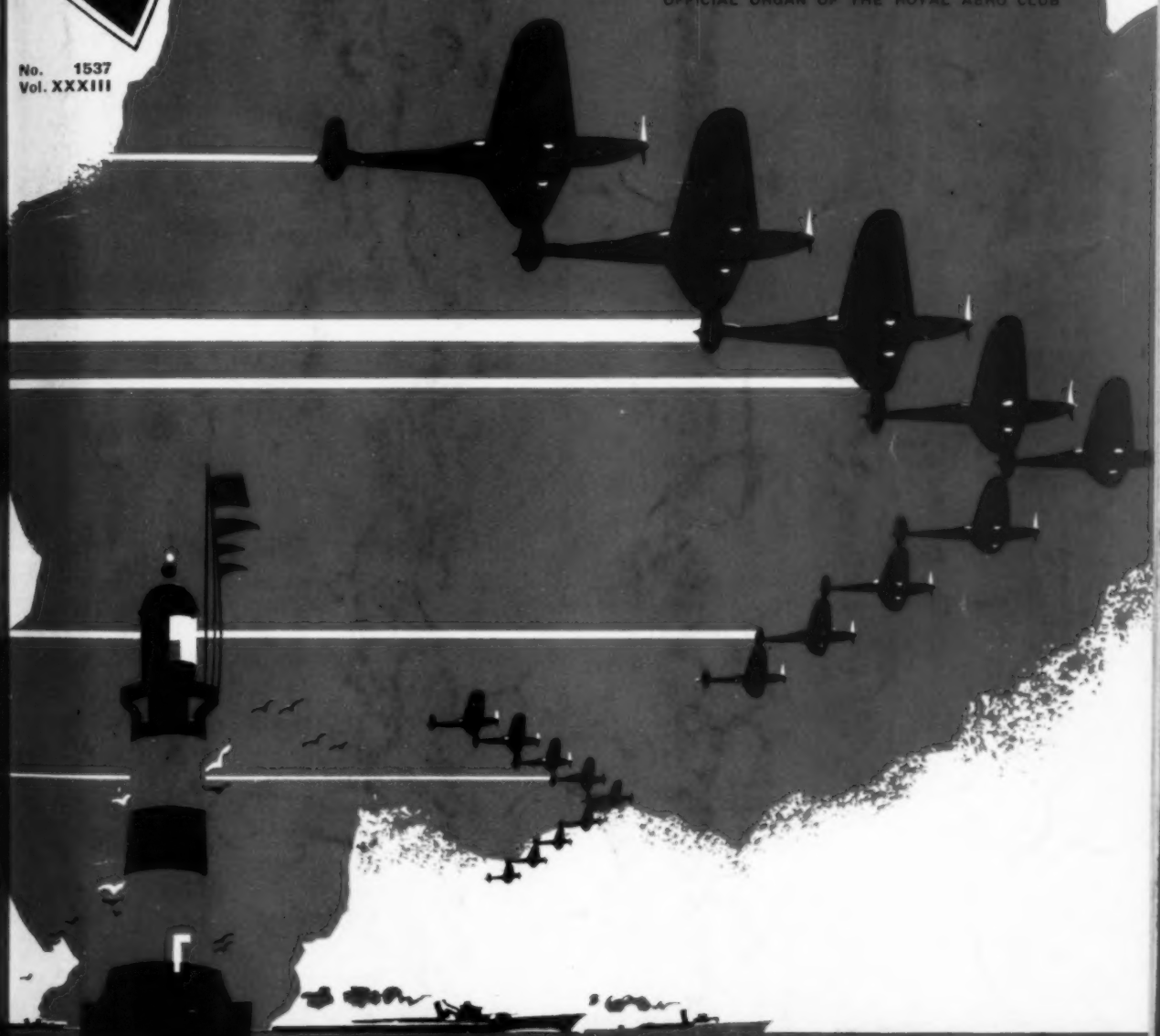

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FLIGHT

The AIRCRAFT ENGINEER AND AIRSHIPS

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

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The Outlook

The Auxiliary Air Force

ECONOMY in matters of defence is now an almost forgotten principle. Everybody, from the Socialist Party upwards, is clamouring that we must be safe, cost what it may. None the less, where we can add materially to our security for a small expenditure of money, it is obviously a good thing to do so, and no item in our defences gives a better return for a small expenditure than does the Auxiliary Air Force. A squadron of the A.A.F. is almost ridiculously cheap, and every one of them is most surprisingly good. No one can grudge the moderate additional expenditure which has just been sanctioned for the officers and men of this admirable Force. The details of pay and allowances which have been granted are set forth fully on the Service Aviation pages of this issue.

Together with the cash grants, one new principle has been introduced, namely, the throwing open of the work of piloting to airmen. Hitherto all the pilots in the A.A.F. have been officers. In the R.A.F. an airman pilot costs less than an officer, and also the use of airman pilots reduced the necessity for engaging short-service officers who have to be thrown out on a hard, cold world after four or more years of service. These considerations did not apply to the A.A.F., where officers and airmen alike cost the country next to nothing, and where all had civilian jobs already.

A.A.F. officers are still cheap, and the change must have been made on more general principles. One has to imagine a state of war, when the A.A.F. squadrons would be mobilised and would go at once on to the same footing and the same rates of pay as the regulars. The absence of airmen pilots would then make a distinction between the Auxiliary and the regular squadrons which would be undesirable and might actually have inconvenient consequences in the matter of replacing casualties. In time of war one wants all the fighting units to be organised on the same plan, and certainly an undue preponderance of officers in any air squadron is a thing to avoid.

The one exception made is the army co-operation squadrons, of which there are now three in the A.A.F. The airmen in those squadrons may wonder, perhaps with a sense of grievance, why they are not offered the same prospects as airmen in bomber and fighter units.

The answer is that in the regular army co-operation squadrons all the pilots have to be officers, and the Auxiliaries must conform. There is a valid reason for this exception. The pilot in these squadrons is actually more of an observer than a pilot. The flying of the machine is regarded as an automatic job to which he need not pay much attention. He must concentrate on reconnoitring for the Army staff, and before he is competent to do that he has to undergo a stiff course of training at the School of Army Co-operation. A second consideration is that his attention must not be distracted from his reconnaissance by thoughts of possible attack from the rear. Therefore, the man in the seat behind him must be a gunner and only a gunner, who devotes his whole attention to watching for possible enemy aircraft. These conditions apply to all army co-operation squadrons, whether they are regular or Auxiliary.

The New Advisory Panel

WHAT the new Air Minister has done as his first act is to set up a new Panel of Industrial Advisers to the Air Ministry. There are seven members, including Sir Charles Bruce-Gardner, executive chairman of the S.B.A.C., and Lord Cadman, of civil aviation report fame. This panel is obviously intended to take the place of Lord Weir, whose resignation from his honorary post as industrial adviser to the Air Ministry is very much to be regretted. There was always a danger that the attack made on the Air Ministry for alleged slowness in producing aircraft might do more harm than good, thus defeating the altogether worthy objects of the assailants. The loss of Lord Weir is certainly one deplorable result of the attack.

So, in place of one adviser who knew a great deal about aircraft production, we get a panel of seven, none of whom knows anything practical about it. We must presume that the S.B.A.C. has accepted this panel with approbation, as its executive chairman is a member of it. Sir Charles Bruce-Gardner was chosen for that post largely because he was outside the industry, and it is scarcely to be believed that in the short time since his appointment he has become an expert on the subject. Lord Cadman, like Lord Nuffield, is a name to conjure with among the Great British Public, and doubtless those who instigated the recent debate in the House will now believe that all is for the best in this

best of all aircraft-producing worlds. We can only hope that they will be proved right.

Despite the proverb that two heads are better than one, we must confess that a single production adviser of proved competence inspires us with more confidence than does a panel of seven; and of course there are lots of proverbs and sayings about cooks and councils of war which we might quote in support of our view.

The possibility must be admitted that our aircraft industry, after having existed for so many years on a starvation diet, has something to learn about mass production methods, and that this panel may be able to supply hints on the subject. But, while mass production is a subdivision of the subject of aircraft production, it is equally true to say that aircraft production is a subdivision of the subject of mass production. The members of the panel probably know much about the subject of mass production, but they still have to learn a lot about the intricacies of aircraft production, and so the guides and teachers must themselves also be learners. And, as we pointed out in a recent issue, it is only to a limited extent that aircraft are suitable for mass-production methods. Designs advance too quickly.

The Cart and the Horse

THAT certain sections of the House of Commons are more concerned about the welfare of the principle of trade unionism within the sphere of civil aviation than about the welfare of civil aviation itself emerged very clearly during the consideration in Committee of the Air Navigation (Financial Provisions) Bill on Tuesday of last week. From 4.20 p.m. until after midnight the debate centred mainly around the question of the dismissal of Imperial Airways pilots and their right to collective bargaining.

Flight has every sympathy with the pilots, and holds the view that the company has in the past not always done all it might have to ascertain the views of its pilots on matters of mutual interest. And allegations were made during the debate which Imperial Airways cannot afford to ignore. But we still think that the relations between Imperial Airways and its pilots is very largely a "family affair," and that the best interests of British civil aviation were not served by devoting so much of the time of the House to a discussion of this particular subject, which is after all but a relatively small aspect of the much greater questions involved.

When the B.A.L.P.A. was formed we expressed regret that a duplication of bodies should have been necessary. At the same time we pointed out that if the G.A.P.A.N. had looked after the financial and other interests of its members as it ought to have done, there would have been no need for the B.A.L.P.A., so that the older body could not altogether escape its share of the blame. The pilots will now decide for themselves, by secret ballot, whether they wish to be represented by the association or by a captain's committee, and there we may leave the subject for the present.

The one promising feature of an otherwise sordid and largely repetitive discussion was the frame of mind in which the new Air Minister, Sir Kingsley Wood, approached the question of subsidies to air lines out of the extra £1½ millions which it is intended to devote to civil aviation.

Reconciliation Problem

IN spite of the very limited time which the debate of the pilots left for the discussion of other aspects, the House did have an opportunity of debating the wisdom or otherwise of limiting the subsidy for external air services to Imperial Airways and British Airways. The Air Minister was faced with a difficult position. The Cadman Committee is generally held to have recommended subsidy to British Airways only on the European routes, although as Col. Ropner pointed out there seems to be some inconsistency between recommendations 9 and 10 of the Cadman Report. The Air Minister is faced with the problem of how to reconcile the general interpretation of the Cadman recommendations and his obvious desire to be fair to everyone who has legitimate claims.

The service to Norway of Allied Airways is, as *Flight* has previously pointed out, rather a special case in that it has the approval of not only the British but the Norwegian Government and works on a fifty-fifty basis with the Norwegian company Det Norske Luftfartselskap. It is, therefore, subject to subsidised competition by the Norwegian company. Apart from that, there is, as we have previously pointed out, considerable advantage to residents of the northern parts of the country, in being able to travel direct to Norway instead of having to come down to London first.

We are, therefore, very glad that Sir Kingsley Wood, with whose difficulties everyone must sympathise, left the door open for a further consideration of the matter by saying that he would submit the case of Allied Airways to his colleagues, and that the Government might be prepared to treat Allied Airways as a special case.

Pirate Programmes

THOUGH the Royal Air Force Display has ceased to operate, the hawkers—with a small "h"—who used to importune the public outside the aerodrome gates have not.

On Empire Air Day they made the approaches to several Service stations their hunting-grounds, and a reader sends a perfect gem of a "souvenir programme" which he purchased outside Northolt aerodrome. Headed "R.A.F. Empire Air Display Pageant," its cheaply printed contents are almost entirely a recitation of events and machines which were *not* appearing in the Northolt show. Quite obviously, it was composed of extracts, haphazardly thrown together, from *last year's Hendon programme*. Even then there were such picturesque extracts as "The 'Blenheim' takes 8.8 minutes to climb to 15,000ft.—again with full load. So that works out at a climb of 13,600ft. per min." On the back of the four-page card is the statement: "Mystery machines—the latest products of British Aircraft manufacture—will be on show on the Aerodromes," and beneath is a drawing of a military biplane that would have looked out of date in 1914.

Of course, anybody who buys programmes from hawkers deserves all he gets. But it does seem hard on eager schoolboys who may hopefully spend their pocket money on these absurd broadsheets. It is surprising that the printers have the boldness to comply with the law by appending their names and addresses to them.

Forthcoming Events

May 28-June 13. Belgrade Aero Show, Yugoslavia.
June 11. Bristol and Wessex Aeroplane Club: Garden Party.
June 18. Lancashire Aero Club: Garden Party.
June 18 and 19. Brooklands Four-club "At Home."
June 22-28. F.A.I. Conference, Berlin.
June 25. Official opening of Wolverhampton Airport.
June 25. Air Display, Gatwick Airport.
June 25. Official opening of Ringway Airport, Manchester.
June 25-July 1. Magyar Pilota Picnic, Budapest.
June 30. Aero Golfing Society: Jubilee Cup, Prince's, Sandwich.
July 2. R.Ae.C.: King's Cup Race.
July 9. Ipswich Aero Club: Flying Meeting.
July 9-17. National Gliding Contests, Dunstable.
July 15. Isle of Wight Flying Club. Rally and Gymkhana Lea Airport.
July 16-18. Deauville Rally.
July 16. Official opening of Luton Municipal Aerodrome by Secretary of State for Air.
July 17-24. Third Littorio Rally, Italy.
July 23. County Flying Club: Flying Meeting at Rearsby, Leicester.
July 29-August 1. Courtrai Rally, Belgium.
July 30. Official opening of Exeter Airport.
July 30. Folkestone Aero Trophy Race, Lympne.
August 20. Eastbourne Flying Club: Garden Party and Opening of New Club-house.
August 27-28. Southend Flying Club: Flying Meeting.
September 3. Cinque Ports Wakefield Cup Race, Lympne.
September 10. Cardiff Aeroplane Club: London-Cardiff Race.
September 11-18. Swedish Civil Aviation Week, Stockholm.
September 21. Aero Golfing Society: Cellon Trophy, Richmond Golf Club.
November 18-December 4. Paris Aero Show.

THE BELGRADE SHOW

A Surprising Amount of New Equipment

FOR the first time, the Royal Aero Club of Yugoslavia has organised an international aero show; the scene is Belgrade, the capital. A number of machines are exhibited for the first time and some are of Yugoslav manufacture. There are three factories in the country—Ikarus, Rogozarski and Zmaj—and one engine works—the Industrija Motora—which builds Gnome-Rhône and Walter engines under licence. The Yugoslav works are reported as having the licence not only for the Hawker Fury but for the Blenheim, the Hurricane and the Dornier Do.17, in addition to their own machines.

The Ikarus IK 2 as shown at Belgrade has an 860 h.p. Hispano Suiza Series Y engine which gives a top speed of 264 m.p.h. It is a braced high-wing monoplane with a fixed undercarriage.

The Zmaj FP 2 is a two-seater trainer biplane with a 420 h.p. Gnome-Rhône engine.

Two types are shown by the Rogozarski works—the R 100 single-seater aerobatic machine (also with 420 h.p. Gnome-Rhône) and the Sim X, a smaller type with a 120 h.p. Walter engine.

In addition to Yugoslavia, Czechoslovakia, France, Germany, Great Britain, Italy, Poland, and the United States are represented at Belgrade. Bristols are showing the sleeve-valve Aquila, and Rolls Royce the Kestrel and Merlin. Other British exhibitors are the Dunlop Rubber Co., High Duty Alloys, Ltd., Simmonds Aerocessories, Ltd., and Smiths Aircraft Instruments.

On the Czech stand is the Tatra T.201 light two-seater which has a 100 h.p. Hirth engine built under licence at the Tatra works and which some weeks ago flew non-stop from Prague to Khartoum.

Two Dorniers

Germany is exhibiting a diesel-engined Do.18 flying boat and a Do.17 bomber. The Arado Ar.95 general purpose military biplane lately presented at Helsingfors as a twin-float seaplane is shown as a landplane. The high-wing Henschel Hs. 126, some notes on the production of which are given on page 568d of this issue, is also there.

One of the most interesting of the light aircraft is the Erla 5-D single-seater which weighs 795 lb. all-up, and which is fitted with one of the new 45 h.p. inverted air-cooled Zündapp engines. The fuel consumption is claimed to be 10 litres for 100 km. The Erla concern is also exhibiting a model of the Erla 55—a wooden cantilever monoplane with a 2-3-seater cabin. This machine was intended for two engines of 40-60 h.p.

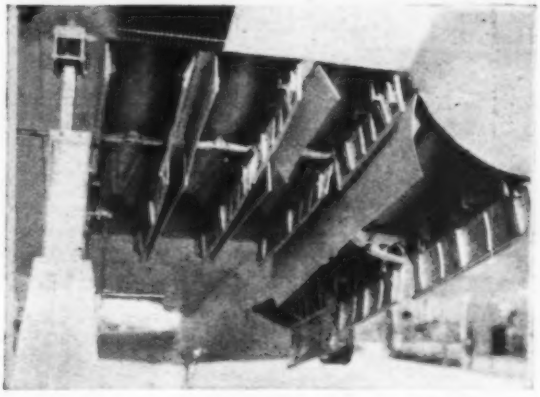
The Siebel works, of Halle, known chiefly for their twin engined four-seater, have lately completed a small machine with a side-by-side seater cabin; this model is planned for an engine of 40-60 h.p.

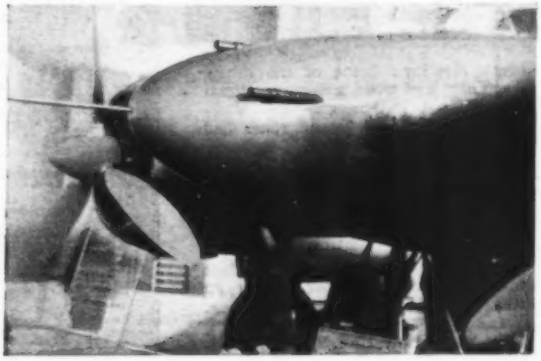
A new air-cooled engine figures in the German section. This is the Breuer five-cylinder radial which has a capacity of 2.24 litres and which develops 40/50 h.p. at 2,300/2,500 r.p.m. The compression ratio of the ungeared model is 6:1, the dry weight is 119 lb. and the fuel consumption 265 gr./h.p./hr.

Prominent in the Italian section is the Macchi C.200 single-seater fighter powered with a Fiat two-row radial of 840 h.p. Data are not given. Even more interest attaches to the Breda 88 bomber-fighter with two 1,000 h.p. Piaggio two-row radials. The top speed is given as 343 m.p.h.

The Cant concern presents its new three-engined six-seater Z.1012 monoplane which is claimed to do 174 m.p.h. and to have a normal range of 620 miles.

On the Polish stand is the RWD-13 tourer equipped as an ambulance. The Polish State Aircraft Factory has weighed in with its PZL-37 bomber which can be powered with two Pegasus or two 14-cylinder Gnome-Rhônes. Three machine guns are fitted. The top speed claimed is 289 m.p.h.





From top to bottom are the new Macchi C.200 single-seater fighter; the Polish twin-engine PZL-37 bomber (which is shown fitted with Pegasus engines); the bomb cells on the same machine; and the nose of the twin-engined Breda 88 fighter-bomber showing the three fixed machine guns.

THE ISLAND

S. T. Lowe Wins Isle of Man Race at 159.5 m.p.h. : Manx Air Derby Won by J. Rush (Tomtit) at 117.

THE hoodoo which appears to have accompanied the Isle of Man race since it was first held two years ago is, it seems, still following the organisers. This year its effects on the long-distance race was not so pronounced, and, despite very heavy rain and a good deal of low cloud over the Isle of Man during the period in which the competitors arrived at Ronaldsway, every starter managed to get through. On Monday, however, when the two circuit races were to be held, there was low cloud, visibility of the mile-two-miles order and a gale which increased in force to something like 55 m.p.h.

Nowadays, Ronaldsway is an extremely important transport centre—the busiest in this country apart from Croydon—and, ignoring the opinions of the organisers and of racing pilots themselves, it was essential that the local controlled zone should be in force during the entire day. Even if the conditions had been possible it was unlikely that the Ronaldsway control would have been able to fit the event in between the regular arrivals of Rapides and 86s.

The competitors for the main race left Hatfield in almost perfect weather with the promise of a more or less consistent following wind all the way to the Island. But at 10 o'clock, in this bright sunshine, the word surprisingly went round that the conditions over the Irish Sea were far from good, and the first man did not actually leave until 11.25 a.m.

On the run to Liverpool, and indeed as far as St. Bee's Head, the conditions could not have been better. Visibility was ten to twenty miles and there was an effective following wind of about 15 m.p.h. Nevertheless, the majority of the competitors flew at heights below 1,000ft. because of the possibility that higher up the wind, though stronger, might veer and, consequently, not be quite so helpful when the loss of time in climbing was taken into consideration. Our own experience (with Mr. Maclaren and the Stanavo Vega) in covering the course at the time was that the assistance even at 7,000ft. was very little greater than that at 1,000ft., and the quite considerable bumps remained until the machine had been climbed above the cloud layer at 6,000ft. or so. Anyway, that expert in the work of making the best possible use of wind and weather when flying a comparatively slow machine, Flt. Lt. H. R. A. Edwards, chose to fly his sports Avian at about 700ft. and his final position in the race, third, showed that his judgment was not at fault.

At Liverpool the leaders were Flt. Lt. Edwards, Mr. R. L. Porteous (Chilton) and Mr. C. G. M. Alington (Desoutter), in that order, with speeds of 122.25, 118.62 and 119.85 m.p.h. respectively. The decimal places are official, and it can only be imagined that the timekeeper at Liverpool had measured the course in fractions of yards and the times in twenty-fifths of seconds. Messrs. Dancy and Rowarth (the latter just back from his part in the Air Ministry's American tour) who were, of course, the official handicappers, were satisfied in the final times to deal in half and quarter miles. They came over with Mr. Buckingham in the Dragonfly entered for the Manx Air Derby.

The first pilot of a fast machine to arrive was Mr. G. R. de Havilland, flying the reconstructed and very much prettier and (more important) faster T.K.2. He had picked up one place from Mr. W. Humble's Sparrow Hawk, which was suffering from a persistently inadequate oil pressure, and had averaged about 200 m.p.h. Mr. S. T. Lowe, the eventual winner and winner of last year's Manx Air Derby, flying his recently acquired but so far unvetted Gipsy Comper, was already showing his disregard for the handicapping and had picked up four places, flying the course to Liverpool at an average speed of 167.5 m.p.h. Although his nearest competitor, Mr. P. Avery, who was handling a modified and very fast single-seater Latvian V.E.F. (the one which, in two-seat form, has been about in England quite a lot), had himself overtaken two other machines, he had lost more than two and a half minutes to Lowe and crossed the line ten seconds behind. Among the slower machines Flt. Lt. Edwards had also gained two and a half minutes on Mr. Porteous, the limit man. The Chilton was going very well, but it

Black Monday: Some of the racing machines (and three non-competitors) picketed out in the gale on Whit-Monday, when the Island races had to be cancelled.

Personalities at the finish: From left to right they are Capt. R. H. Stocken (the organising manager), Maj. Gen. Wenninger (the German Air Attaché), Vice-Admiral the Hon. W. S. Leveson-Gower, C.B., D.S.O. (the Lieutenant-Governor), Councillor W. C. Craine (the Mayor of Douglas), and the Misses Sheila and Mabel Glass.

"Flight" photographs.

...NGAIN

...ald Race at 148 ... Day Posponements

The scene (right) on and beyond the tarmac at Hatfield before the machines were taxied out to the starting line. The change in the weather conditions between start and finish is obvious.

(Below) One of the two German entrants in the race, Maj. Seidemann, who finished seventh, taxies in his Ago 192 while two other machines make their landing circuits.

"Flight" photograph.

suffered minor airscrew trouble during the latter part of the flight, when the leading edges had chosen to part from the rest of the blades at the tips. Mr. Ward, fearing such trouble with an untested airscrew, was at Speke with a spare and this was fitted while the machine was refuelled with the phenomenal amount of four gallons required to top up the tank. The Chilton's average, though high, was obviously not great enough to obtain a place and the pilot knew that the rain which was expected near the Island was likely to damage the new airscrew.

The Ratier-airscrewed Mew Gulls at scratch—if, one starting before the other, their Hatfield positions can each be termed—had held their places, though Mr. A. Henshaw's had picked up nearly all of Mr. G. Guthrie's one and a half minutes' original lead. They actually arrived at Speke within fourteen seconds of one another. Guthrie's Mew, incidentally, was that previously owned by Mr. Charles Gardner, who won last year's King's Cup with it; Guthrie had only been flying the machine for a week or two. One of the two German competitors, Herr F. Pasquay, was already suffering cowling trouble with his B.F.W. Me.108, and Major Hans Seidemann's Ago Ao.192 was not travelling quite as quickly as its appearance had led one to expect. This twin-engined machine, designed for economically fast mail or personal transport, was fitted with two of the very first variable pitch airscrews to be produced by the Schwartz people.

As the competitors turned at St. Bee's Head both the weather and the visibility began to deteriorate, and the Isle of Man was to be discerned in due course as a sombre rain-cloud extending over a third of the horizon. In fact, dry land was not seen by the pilots until they were passing Douglas Bay—Maughold Head having been cut out of the course after last year's *débâcle*. It was raining hard, to the excessive discomfiture of the spectators and officials, at Ronaldsway, and a special series of unpleasant-looking low clouds had been manufactured by Snaefell. Visibility was, at times, so comparatively poor that at least two of the competitors took the wrong turning near Douglas, thinking that they had overshot Castletown. These two were Avery and Guthrie, and their speeds, in comparison with those of the other entries, and with their own as far as the Speke Control, showed just what they had lost by this misfortune. Guthrie's Mew actually finished in fifth place, tying with Pasquay's B.F.W. Avery arrived in ninth position, but it is unlikely whether, even without his little navigational trouble, he would have managed to pass Herr Clausen's very fast Klemm 35, which crossed the line more than five minutes ahead of him.

A study of the speeds over the whole course in comparison with those registered as far as Speke, suggests that the over-all wind assistance was rather less than 10 m.p.h.

Although the difference of eighteen minutes between the arrival times of the first and last machines at Ronaldsway might appear to be somewhat extravagant, it must be remembered that the course is quite a long one and the wind conditions very difficult to estimate. Practically speaking, the rain-sodden spectators at Castletown had the impression that the machines were coming in over the line one after another, and, in fact, after the first three arrivals, there were some quite exciting finishes. The winner, Mr. S. T. Lowe, came over the line alone and leading Mr. A. Henshaw's Mew Gull by more than a minute. The

"Flight" photographs

On the left, the second and first pilots home, Messrs. A. Henshaw and S. T. Lowe, face the weather with the former's Gipsy Comper in the background. (Right) The third to arrive, Flt. Lt. H. R. A. Edwards, emerges from his Avro Avian; very wet.

latter, too, arrived nearly a minute before Flt. Lt. Edwards' Avian, and though Edwards had lost about forty seconds at Hatfield, when his engine refused to start, it is not likely that this loss of time made any difference to the final placings. Henshaw had averaged a record speed of 247.5 m.p.h.

After two years of the Isle of Man race week-end—and two of comparative failure at that—the fact that the entry list was larger than ever shows that there is much more in this Island event than mere air racing. Quite obviously the competitors enjoy the race equally as an excuse to attend what is virtually a very good flying party—one of the season's best.

One day, perhaps, other persons will join Mr. J. M. Cubbon in providing really useful prize money for the event, and in that case it would seem almost as if it will become the most important air race in this country. In all there were twenty-nine entries for one or more of the three races, and of these twenty-three put in an appearance. Of the non-starters, Flt. Lt. T. Rose's engine had apparently been sold and Mr. Henshaw Senior's insurer had voted against his participation in the races. Needless to say, he was over in the Island with the Vega Gull—Flt. Lt. H. J. Wilson (a previous competitor) as chauffeur. Flt. Lt. Clouston's entry had been unfortunately cancelled at the last minute owing to the illness of his wife.

This year there were no criticisms of the organisation, but it might be suggested that the race committee should arrange for, say, a couple of experienced ground engineers to be brought over from Liverpool or elsewhere specially for the event. In almost any race of this kind the competitors experience little troubles which can be rectified at once by competent engineers, and it is obviously impossible for those permanently on duty at Ronaldsway, and with other transport machines on their hands, to do justice to twenty-odd machines of different types. The German contingent brought over their own engineers and these proved to be extremely useful when two of the Messerschmittts suffered cowling trouble.

Despite a somewhat depressing morning weather report, the two circuit races were, after all, held on Tuesday. The Manx Air Derby was won by Mr. J. Rush (Tomtit) at a speed of 117 m.p.h., with Herr Ernst Gerbrecht (Focke Wulf Stieglitz) and Mr. A. Henshaw (Mew Gull) as runners-up at speeds, respectively, of 109 and 239 m.p.h. The first three in the Tynwald Air Race, for machines of 120 h.p. or less, were Mr. S. T. Lowe (Gipsy Comper), Flt. Lt. H. R. A. Edwards (Avro Avian) and Mr. R. L. Porteous (Chilton) in that order at speeds of 148, 102 and 99 m.p.h. We hope to publish a report of these events, which were run concurrently, in next week's issue.

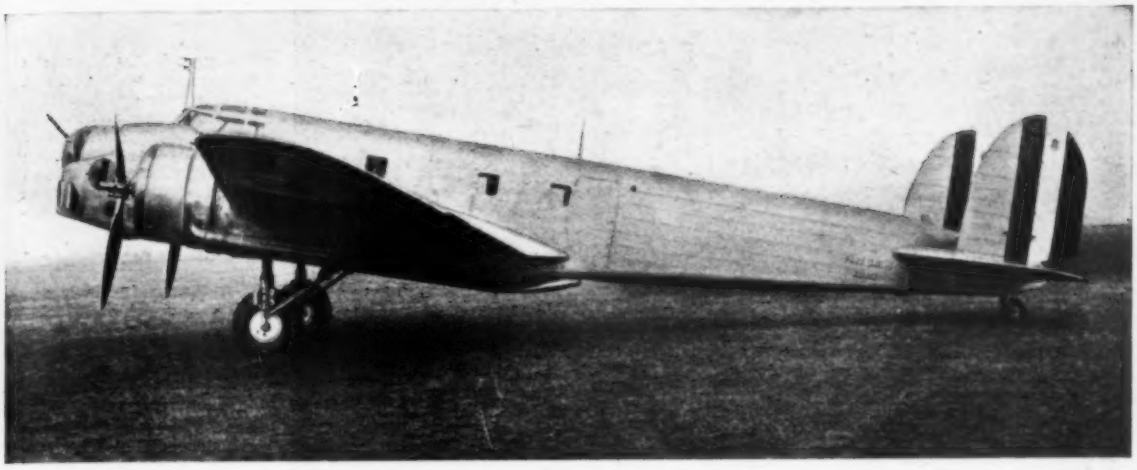
ISLE OF MAN AIR RACE.

Finishing Order.	Machine.	Pilot.	Finishing Time.	Flying Time.	Speed.
			hr. min. sec	hr. min. sec.	m.p.h.
1	Gipsy Comper ...	S. T. Lowe*	14 55 28	1 51 21	150.5
2	Mew Gull	A. Henshaw	14 56 30	1 11 41	247.5
3	Avian IV	H. R. A. Edwards ...	14 57 27	2 31 07	117.5
4	T.K.2	G. de Havilland ...	14 58 33	1 32 35	192.0
5 }	B.F.W.Me.108 ...	F. Pasquay	15 00 15	1 32 50	191.5
5 }	Mew Gull	G. Guthrie	15 00 15	1 17 02	230.5
7	Ago192	H. Scidemann ...	15 00 49	1 25 33	207.5
8	Klemm 35	F. W. Clausen ...	15 01 59	2 07 37	139.25
9	V.E.F.J.12	P. Avery	15 03 56	2 02 07	145.5
10	Chilton	R. L. Porteous ...	15 04 34	2 30 34	111.25
11	Sparrowhawk ...	W. Humble	15 04 36	1 43 17	172.0
12	Tomtit	J. Rush	15 04 53	2 24 12	123
13	Miles Magister ...	T. M. Barwick ...	15 06 26	2 05 24	141.5
14	Stinson	J. Kirwan	15 08 45	2 13 31	133
15	Desoutter	C. G. M. Alington ...	15 10 27	2 36 35	113.5
16	Beta 51	Lt Col. J. Kalla ...	15 13 15	2 24 24	123

* Receives the London to Isle of Man Air Race Challenge Trophy and replica presented by Germ Lubricants. The winner and the second and third men receive £125, £75 and £50 (presented by Mr. J. M. Cubbon).

"Flight" photograph

The winner taxies in: Mr. Lowe about to notice the difference between horizontal and vertical rainfall.



SOME FIAT IMPRESSIONS

A Call at the Famous Turin Factory : Aero Engines, Bombers and Fighters in Production

ON his way back from Venice last week a member of the staff of *Flight* was able to drop off at Turin and make the rounds of the Fiat works. His guide round the aero engine section was the chief designer, Signor Bona, who graciously professed admiration of some of our own departures in engine design. He explained that, although liquid-cooled engines are still going through the works (chiefly for the Fiat C.R.32 fighters), an "air-cooled" policy has been adopted and has seen fruition in two types of two-row radial—the eighteen-cylinder A.80 and the smaller A.74 "fourteen." To tide them over the development period the company obtained the Pratt and Whitney licence and built a number of Hornets.

The A.80 is the first eighteen-cylinder radial to go into large-scale production, and, as exemplified by the A.80 RC41, gives a normal output of 1,000 h.p. at 13,000ft. for a weight of 1,600 lb. Using the Fiat-Hamilton constant-speed airscrew the take-off power is 1,030 h.p.

Normally delivering 840 h.p. at 12,500ft., the A.74 RC38 (47in. diameter) is the power plant of the Fiat G.50 fighter, now in series production at Pisa for the Regia Aeronautica.

Cylinder heads for both models are cast and have two inclined valves apiece. The supercharger is a centrifugal type, the impeller-crankshaft gear ratio for the A.80 RC34 being 9.37 to 1.

Starting is by compressed air on the Garelli system, partly because of the good results obtained and partly to avoid interference with supercharger design.

It may not generally be realised, by the way, that the A.30 vee-twelve water-cooled unit used in the C.R.32 fighter maintains its power up to nearly 10,000ft. not through supercharging but by the use of an 8 : 1 compression ratio.

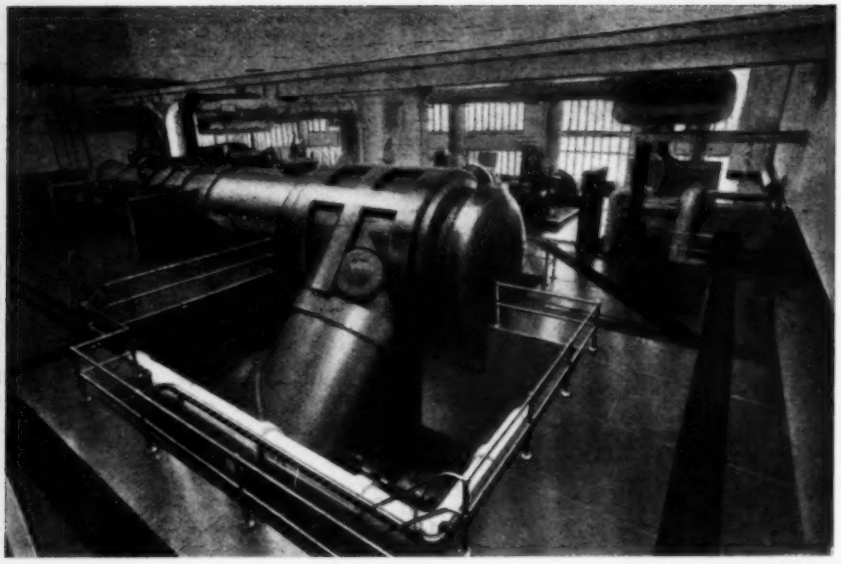
We were particularly impressed by the room where engines are tested under high-altitude conditions. This is probably the only one of its kind in existence and proved invaluable in the development of the current types of supercharged engines. The vast explanatory diagrams on the walls and the grouping of all the controls and dials on a central panel give the room a Wellsian air. Eight hundred h.p. is required for cooling.

At the aerodrome, whither we were taken, we were shown Fiat-Hamilton airscrews in production. Fiats have stolen a march on De Havillands by getting into production with the constant-speed version. According to Signor Gabrielli, the designer of the G.18-V and the G.50 fighter, it is a very great advance over the two-position type.

In the aircraft works we saw the C.R.32 single-seater biplane fighter and the B.R.20 bomber in quantity production for the Regia Aeronautica.

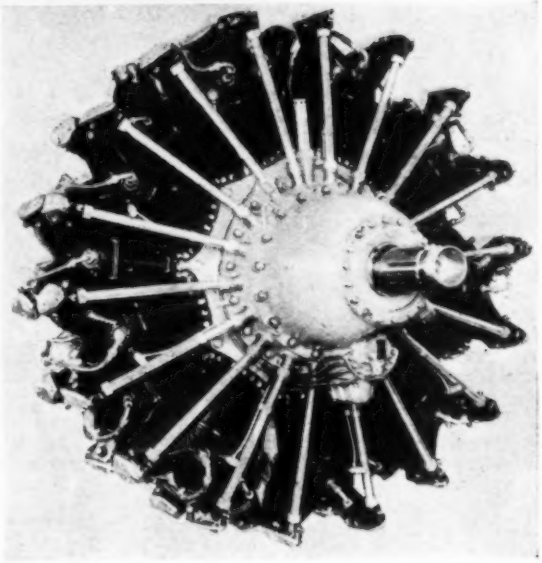
The C.R.32 may be regarded as the opposite number

The Fiat B.R.20, seen in side and front elevation on this page, has a top speed of over 260 m.p.h. This machine is in quantity production for the Regia Aeronautica



The room in the Fiat works where engines are tested under conditions simulating those encountered at altitudes up to 30,000ft. A plant of this nature is very expensive but the Fiat company feel that it is worth while for the checking of estimated performances and for general research with supercharged engines.

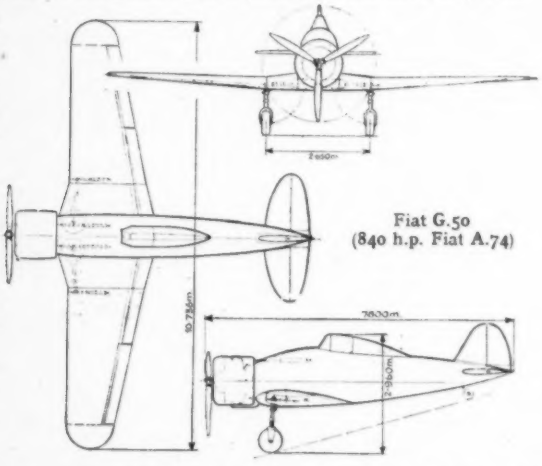
(Below)
The Fiat A.80 eighteen-cylinder radial of 1,000 h.p. —the first eighteen-cylinder radial to go into quantity production.



to our Hawker Fury, and until the Spanish war was virtually out of production.

Though capable of only about 220 m.p.h. the machine, with its Warren girder wing bracing is tremendously strong and manœuvrable. Mussolini has publicly commended it for the results it has given in Spain, whither, incidentally, the machines we saw coming off the line, were destined. Some years ago a Russian mission turned the C.R.32 down on the grounds of its obsolescence.

There is a tendency in Italy to reduce the armament of fighters to a minimum rather than to multiply it as we have done in the Hurricane. Even the 300 m.p.h. Fiat G.50 monoplane in production at the Fiat factory at Marini di Pisa normally has only two guns. According to Signor Gabrielli, if the authorities could find some positive safeguard against jams it would have only one.



The C.R.32 mounts two machine guns of heavy calibre (0.5in. approx.) firing through the airscrew arc, their blast channels protruding from the top fairing. Loading and firing is effected by a "twist grip" attachment on top of the stick, the Italian pilots, apparently, preferring this method to press-buttons or a lever. The optical sight has attachments for a miniature ring and bead which make the British counterparts look clumsy.

Bombers of the B.R.20 type are also being used in Spain. This twin-engined monoplane has a wing built round two riveted duralumin spars; the fuselage is a welded structure and is quite roomy.

Bombs are carried in the belly of the fuselage forward of the lower midships gun position. Breda power-driven turrets are fitted in the nose and on top of the fuselage; the ammunition boxes form a semi-circle.

Manufacturer's data for the B.R.20 with two A.80 RC41 engines are: Top speed 267 m.p.h. (which is more than one would have guessed); ceiling, after release of bombs, 36,000ft.; weight empty 14,330 lb.; weight loaded, 24,250 lb. Like the C.R.32, it was designed by Signor Rosatelli.

A small series of bomber-fighters is going through. Two A.74 engines are fitted and four fixed guns are mounted.

Industrial Advisers to the Air Ministry

SIR KINGSLEY WOOD, Secretary of State for Air, has appointed a Panel of Industrial Advisers to the Air Ministry, and the following have agreed to serve on it: Sir Amos Ayre, O.B.E., a member of the council of the Institution of Naval Architects; Mr. S. R. Beale, chairman of Guest, Keen and Nettlefolds; Mr. J. W. Bowen, president of the Post Office Employees' Approved Society, who was also a member of the Cadman Committee; Sir Charles Bruce-Gardner, executive chairman of the S.B.A.C.; Lord Cadman, chairman of the Anglo-Iranian Oil Co. and of the Iraq Petroleum Co.; Lieut.-Col. J. M. Greenly, C.B.E., chairman of Babcock and Wilcox; and Sir Malcolm McAlpine, K.B.E., chairman of Sir Robert McAlpine and Sons.

[Editorial comment on these appointments appears on page 559.]

SERVICE AVIATION

Royal Air Force and Official Announcements : Fleet Air Arm News : Military Aviation Abroad

Empire Air Day Attendances

OFFICIAL attendance figures issued after Empire Air Day, May 28, show that, in spite of the adverse weather, the total attendance at the eighty-odd R.A.F. stations which were open to the public was in excess of 421,000, as compared with 353,000 last year, while the net takings amounted to approximately £18,000, as against £14,000 in 1937.

The largest attendance was recorded at Northolt, where nearly 23,000 visitors were present—a record for any Empire Air Day at any station. The number visiting Tern Hill, Shropshire, which previously held the record, was approximately 22,000.

Other large attendances were Castle Bromwich (19,500), Sealand (18,500), Martlesham (17,000), and South Cerney (16,500).

Restrictions at Hendon

THE use of Hendon aerodrome by visiting Service aircraft, except in emergency, is restricted to aircraft the occupants of which have duties to perform at Hendon or who are proceeding on duty to London.

Troop-carrying

A LARGE-SCALE troop-carrying exercise was carried out on Wednesday of last week when parties of Coldstream Guards were transported from Odiham, Hants, to Catterick Camp, Yorkshire, in Vickers Valentia bomber transports. On arrival they took part in a field exercise against troops of the Northern Command.

Marking Obstructions

RED flags will no longer be used for indicating bad ground and areas under repair and for supplementing standard markings. Instead, short stakes, placed in pairs three or four feet apart, with strips of canvas about a foot wide attached to and stretched between each pair, will be used. The canvas will be painted white.

R.A.F.V.R. Blazer

APPROVAL has been given for the wearing of a special blazer by members of the Royal Air Force Volunteer Reserve; a badge will be granted after they have qualified in their respective categories. The blazer is double-breasted and has chromium-plated buttons. The badge is worn on the breast pocket and has the emblem of an eagle surmounted by the letters "V.R." and surrounded by a laurel wreath, the whole being surmounted by a crown. The provision of the blazer will be the responsibility of the individual.

Move of No 1 F.T.S.

NO. 1 Flying Training School, which trains naval pilots for the Fleet Air Arm, will move from Leuchars to Netheravon in August. It may be concluded from this that the latter station will in due course be handed over to the Admiralty.

When this move has taken place naval officers and also officers of the Royal Marines will receive their preliminary flying training at the civil school at Sywell, while naval ratings will go through their preliminary course at Rochester.

The first batch of naval ratings who are training as pilots arrived at Leuchars on May 9. The batch consists of twenty sailors, none of whom holds the rank of petty officer.

Eastchurch Wins Rifle Match

AT the R.A.F. Rifle Meeting last week the Trenchard Challenge Cup for station teams of eight was won by the Air Armament School, Eastchurch, with a record score. This is the fourth year in succession that Sqn. Ldr. J. C. Stevens has led his team to victory, and the seventh time that Eastchurch has won since the present conditions came into force in 1927.

The Eastchurch team and scores were as follows: Flt. Sgt. Collins, 169; Warrant-Off. Le Gras, 168; Flt. Lt. Fraser, 167; Flt. Sgt. Willott, 165; Warrant-Off. Hampshire, 163; Flt. Sgt. Blake, 152; F/O Birch, 144; Flt. Sgt. Anderson, 128; total, 1,256. The runners-up, Gosport, scored 1,169.

The Brooke-Popham-Steele match for Squadron teams of four, under standard Service conditions, was won by No. 206 (G.R.) Squadron.

New Unit Badges

THE King has approved the following badges and mottoes for the units concerned and they may now be taken into use in accordance with the official scheme adopted in January, 1936:—

Unit.	Badge.	Motto
No. 76 (B) Sqdn. ...	In front of a rose a lion passant guardant.	Resolute
No. 77 (B) Sqdn. ...	A thistle	*Esse Potius Quam Videri*
No. 83 (B) Sqdn. ...	An attire	Strike to defend
No. 107 (B) Sqdn. ...	A double-headed eagle displayed gorged with a collar of fleurs de lys.	*Nous Y Serons*
No. 9 Flg. Trng. School	An eagle rising from an open book.	*Docendo Discimus*
R.A.F. Stn., Kalafrana	A Maltese cross, and an eagle volant.	*Nunquam Defuimus*
Marine Aircraft Expl. Estab.	A balance	Trial by air and sea.

Auxiliary Air Force

NEW conditions of service have been approved for the Auxiliary Air Force. They have been recommended by a committee which sat with Lt. Col. Muirhead, late Under-Secretary for Air, as chairman, and have been approved by the Air Minister. They were explained to the commanding officers of the squadrons by Capt. Balfour, the new Under-Secretary, on Thursday, June 2. The principal recommendations of the committee are:—

In order that the squadrons may be at all times at full effective strength their establishments will be enlarged to carry appropriate numbers of officers and airmen under training in addition to the full complement of completely trained officers and men.

The field of recruitment of flying personnel to fill these enlarged establishments will be widened so that in future A.A.F. squadrons will be manned on the same basis as R.A.F. squadrons and, with the exception of the A.C. Squadrons, will include airman as well as officer pilots. Airman pilots will be recruited both from existing airmen of the squadrons and from volunteers directly entered for the purpose. There will also be opportunity for airmen in the squadrons and for new recruits to undertake air duties as observers, wireless operators and air gunners.

The financial conditions of service will be improved to take account of the heavy demands on the time of these volunteers, especially of volunteers for flying duty, that the A.A.F. makes. The issue of pay and allowances, as for R.A.F. personnel, is not generally suitable to the conditions under which training is done in the A.A.F. and will be confined to occasions of continuous training such as annual camps. The main training is done on evenings and at week-ends, and for such training officers and airmen will receive, in addition to full travelling expenses, a training allowance graduated on a scale intended to cover meals and all incidental expenses which are incurred. The amount issued for each hour of useful attendance, whether on evenings or at week-ends, will be as follows: Members of officers' mess 1s., members of sergeants' mess 9d., corporals 7d., aircraftmen 6d.

All airmen who carry out the requisite training will, as at present, receive an annual bounty amounting for recruits to £3 10s., and for trained men to £5.

The above emoluments will be issuable to all personnel both of the Flying Squadrons and of the Balloon Squadrons, whether their service is in the air or on the ground. The special responsibilities of flying personnel will be recognised by a further emolument, to be called flying pay, at the following rates: Officer pilots, £25 per annum; airman pilots, £20 p.a. (in addition to the £5 bounty); observers, wireless operator-air gunners and air gunners, £15 p.a. (in addition to bounty).

Service Aviation

Royal Air Force Gazette

General Duties Branch.

The following Flt. Lts. are promoted to the rank of Sqn. Ldr. (June 1):—A. E. Dark, W. J. H. Lindley, N. H. Fresson, A. P. F. M. Berkeley, T. B. Cooper, V. S. Bowling, C. H. Turner, J. A. Powell, F. R. Drew, H. Ford, C. W. Grannum, C. V. J. Pratt, F. J. St. G. Braithwaite, W. M. L. MacDonald, H. St. G. Burke, C. M. Champion de Crespigny, E. G. Granville, G. F. Humphries, D. W. Lane, C. D. C. Boyce, R. L. Mills, N. C. Singer, K. W. Niblett, W. S. Hebden, W. V. L. Spendlove, F. W. Stannard, M. E. M. Perkins, J. D. Baker-Carr, G. F. Alexander, A. C. Watson, G. K. Tulloch, R. A. Sprague, L. E. Jarman, H. R. Dale, L. Croker, E. R. M. Walker, W. R. Beaman, G. Farnhill, T. W. Hodgson, C. E. Morse.

The following Flying Officers are promoted to the rank of Flt. Lt. on the dates stated:—J. H. Lowe (Jan. 28); C. A. H. Evans (March 2); T. I. Davies (May 22).

Wing Comdr. P. B. Hunter is placed on the retired List at his own request (May 17).

Equipment Branch

Flt. Lt. F. E. R. Dixon, M.C., is promoted to the rank of Sqn. Ldr. (June 1).

Accountant Branch

Flt. Lt. S. W. Hill is promoted to the rank of Sqn. Ldr. (June 1).

Royal Air Force Reserve

General Duties Branch

The following are transferred from class A to Class C on the dates stated:—Flt. Lt. M. F. Summers (Oct. 30, 1937); Flt. Lt. W. G. A. Coulson (Feb. 12).

Auxiliary Air Force

General Duties Branch

Maj. M. G. E. Walker, D.S.O. (R.A., Ret.), is granted a commission as Flt. Lt. (April 11).

Royal Air Force Appointments

General Duties Branch

Wing Commanders.—M. Thomas, D.F.C., A.F.C., to H.Q. No. 5 (B.) Group, Grantham; for duty as Senior Air Staff Officer. 16.5.38. H. O. Long, D.S.O., to H.Q., Bomber Command, Uxbridge; for Equipment (Engineer) Staff duties. 9.5.38. W. E. Swann, to No. 1 School of Technical Training (Apprentices), Halton; to command No. 4 (Apprentices) Wing. 11.5.38. G. T. Richardson, to R.A.F. Station Church Fenton; to command. 11.5.38.

Equipment Branch

Wing Commander.—J. A. Stone, to "B" Maintenance Unit, London, to command. 20.5.38.

Squadron Leaders.—J. H. C. Wake, to R.A.F. College, Cranwell; for duty as Chief Ground Instructor. 11.5.38. F. C. Rowland, to No. 3 F.T.S., South Cerney; for Administrative duties. 4.5.38. H. H. Martin, to No. 206 (G.R.) Sqn., Bircham Newton; to command. 9.5.38. A. D. Selway, to No. 14 (B.) Sqn., Amman, Transjordan, to command. 4.5.38. G. H. H. Procter, to No. 3 (Indian) Wing H.Q., Chaklala; for Air Staff duties. 4.5.38.

Flight Lieutenants.—J. K. Brew, to H.Q., R.A.F., Iraq, Habbaniya. 23.4.38. P. B. H. Butler, to No. 8 F.T.S., Montrose. 12.5.38. G. A. V. Clayton, to No. 201 (G.R.) Sqn., Calshot. 6.5.38. G. F. Alexander, to R.A.F. Station Seletar, Singapore. 14.5.38. D. S. Kite, to No. 1 A.A.S., Eastchurch. 9.5.38. E. T. Smith, to C.F.S., Upavon. 5.5.38. G. W. Golledge, to No. 609 (West Riding) (B. Sqn.), Yeadon. 16.5.38.

FOREIGN SERVICE NEWS

The Torpedo-Bomber—A New Conception

FOR years the French have been using large twin-engined float-planes for coast-defence work from sheltered waters. More recently the Hall Company has developed a modern twin-engined monoplane for similar duties with the U.S. Navy, and now Fokker announces the design of a smaller machine, with two engines of 400 to 750 h.p. each (the Hall has two 1,100 h.p. Twin Wasps) for torpedo dropping and reconnaissance with a crew of three.

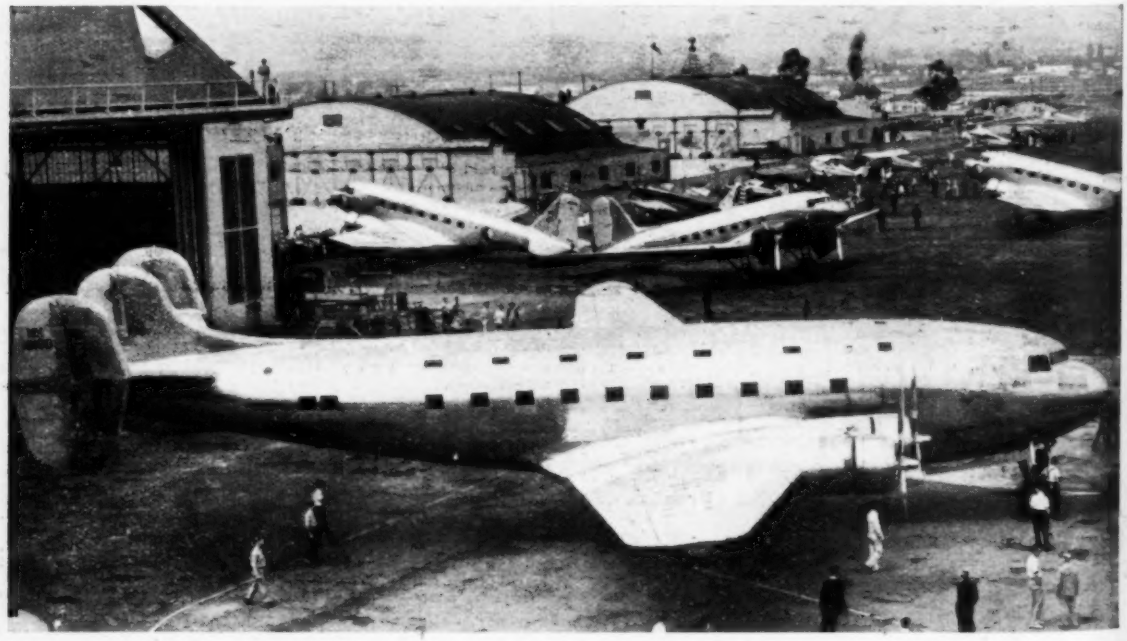
Known as the T.8-W, the new design incorporates internal stowage for the torpedo or bomb load. The release gear is electrically locked until the trap doors are fully open. The pilot has a fixed gun and the wireless operator has access to a second weapon on a shielded mounting at the rear of the cockpit enclosure.

French Air Strength

THE French Air Minister, M. Guy La Chambre, last week gave some details of the Government's programme. Provision of a first-line strength, by April, 1940, of 2,600 machines, 900 being fighters, has been made. Delivery of American Curtiss P.35 fighters is to begin in November and be completed by April, 1939.

German Bombers Visit Yugoslavia

THIRTY-EIGHT German military machines, of which thirty-one were bombers, have lately visited Belgrade at the invitation of the Yugoslav Air Force. This is the first time since the war that a German Air Force formation has made a courtesy visit abroad.



D.C.4 EMERGES: After successfully passing some remarkable static tests, as described on the opposite page, the Douglas D.C.4 appears in the open. The huge proportions of this latest tricycle transport can be gauged from the familiar Douglas types in the background.

Up-loads of 180,000 pounds applied to outer and inner wing sections by pulleys operating over these steel superstructures and hydraulic jacks pushing up under wings. Each wing takes 90,000 pounds. Hydraulic system inside plane tested by this control.
Down-loads of 50,000 pounds applied to engine nacelles on each side of plane reproducing weight and pull of engines. Total down-loads 180,000 pounds.
Test engineers at hydraulic control board. Total up-loads of 170,000 pounds and side-loads of 35,000 pounds to each wheel were applied to landing gear. Nose wheel took up-load of 42,000 and side-load of 10,000 pounds.
Photo diagram showing proof test of Douglas DC-4 super skyliner. Position of ship reproduces on the ground all loads and stresses anticipated by engineers when plane, fully loaded and traveling at 235 miles per hour is sent into high angle of attack for climb at rate of 2,000 feet a minute. Scores of engineers and experts worked weeks to design and supervise tests in which the one pictured above was the dramatic climax.

This annotated photograph, issued by the Douglas Company, gives a good idea of the general scheme of the tests.

STATIC TESTS of the D.C. 4

Prelude to Initial Flights of America's 30-ton Giant

TO quote a Douglas Press release, "Out in Santa Monica, California, Douglas engineers have just finished the job of flying and landing the nation's largest and finest commercial transport without taking it out of the hangar.

"It was a task in which mathematics and a million pounds of lead bars were handled in equal proportions, with slide rules and elbow grease doing their share.

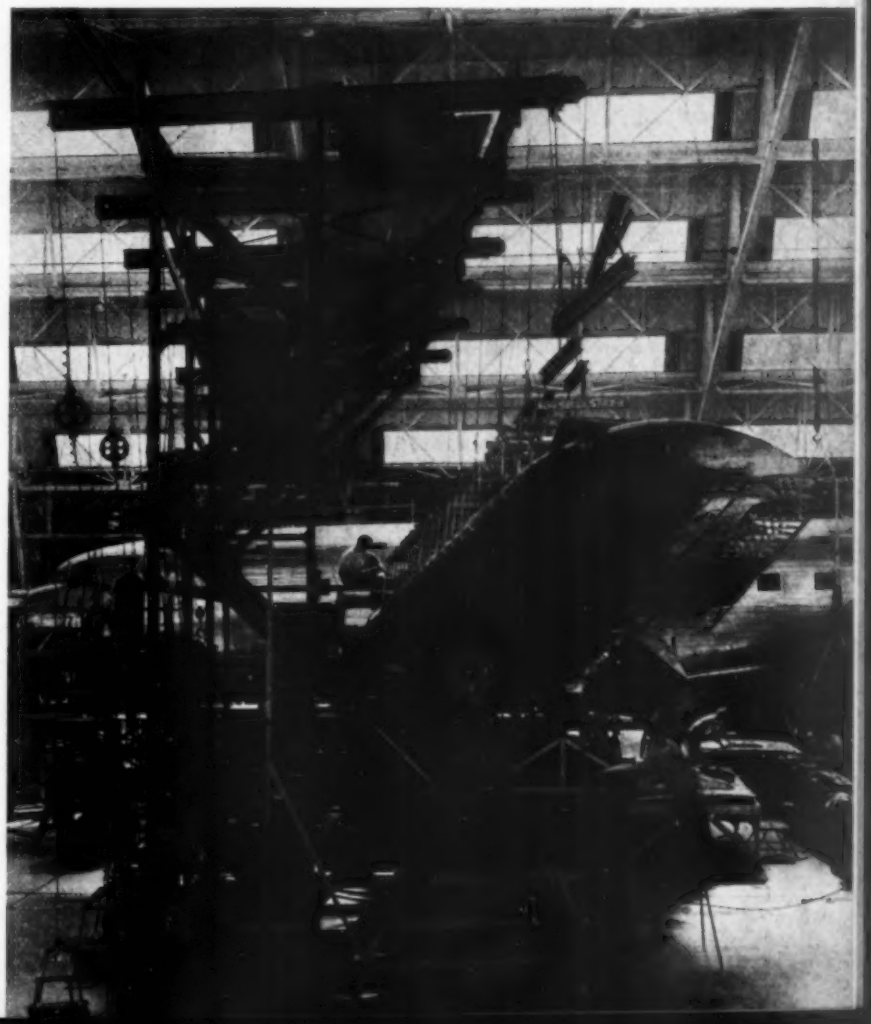
"When the last test was finished and the final figures checked and rechecked, the 65,000 lb. D.C. 4, designed and built by Douglas to the order of the five major airlines, was pronounced ready and fit for its acceptance flights."

Normally prototype machines are turned upside down for static tests and the loads are piled on the wings and fuselage. The D.C. 4, however, was too large to be handled so unceremoniously.

Several rehearsals of the tests were held to ensure that each man knew his job. Deflection readings were taken at 201 separate points on the machine. Some were made to load factors of three and a third times the gross weight of the aeroplane. The most complicated and spectacular of the tests were made on the outer wing panels to simulate deflection duing flight. To reproduce this condition pulleys and cables were hooked on to the leading edge and upper skin from tall steel structures. Twelve men at the end of blocks and tackles gradually increased the load at given signals, while under the inner wing sections hydraulic jacks, operated from a central control panel, pushed upwards.

One test was made with the D.C. 4, in the "high angle of attack" position. This reproduced all the forces exerted were the machine to be zoomed at the rate of 2,000ft. a minute from level flight at 240 m.p.h.

Mechanics working on control adjustments were so far apart that a loud-speaker telephone system had to be fitted up for communication.



Showing details of the gear with which loads of 180,000 lb. were applied to the wings of the D.C. 4.

ASTRONOMICAL NAVIGATION

A Simple Explanation of the Principles : The Greenwich Hour Angle : Making Use of the "Air Almanac." Part I

By Sqn. Ldr. E. H. D. SPENCE, R.A.F.O.

THERE seems to be a general impression amongst airmen that astronomical navigation is a very difficult matter, and in particular that an intimate knowledge of spherical trigonometry is required. If, however, one pauses to consider that thousands of sea-going men of all nationalities make daily use of it, would this not tend to prove that it cannot be so very difficult after all, bearing in mind the old Naval saying that "the fool of the family goes to sea"? There is also another ancient saying which runs, "What one fool can do, another can." So let us take heart, and try to understand this mysterious subject.

What, in the first place, are we trying to do? We are trying to find some means of ascertaining our position when out of sight of land, either when flying over the sea or when flying above the clouds. If by some means we were able to find out the distance (in any convenient unit) and the bearing of a spot whose position we know, we could then—if the chart or map were big enough—lay off the bearing and the distance to this spot. It is a very similar proposition to a radio bearing, with the addition of the element of distance.

Simple Principles

In astronomical navigation use is made of a number of imaginary spots on the earth's surface, the bearing and distance of which are found as will be explained later. The position of these imaginary spots are tabulated in the *Air Almanac* at short intervals of time; they are the points where a line joining a celestial body (such as the sun, planets, stars or moon) to the centre of the earth cuts the latter's surface. The points on the earth's surface are known as the sub-solar, sub-planetary, sub-stellar and sub-lunar points, or, generally, as the Geographical Position (G.P.) of the celestial body. The G.P.s will be constantly altering as the earth revolves on its axis: their progress is, however, followed in the *Air Almanac*. A little explanation of the theory on which we will work is now necessary.

Imagine the heavens to be a colossal bowl which is an enormous distance away; also that we can project the earth's equator and poles, from its centre, on to the inside of this celestial sphere. The projections are known as the celestial poles and the celestial equator. The stars are so far away that they appear always to remain in the same place in the celestial sphere, and their positions in it can be fixed by what corresponds to latitude and longitude on the earth; celestial latitude is called Declination (Dec.), and celestial longitude (which is *not* measured from the projection of the Greenwich Meridian but from a fixed point on the celestial equator) is called Right Ascension (R.A.). We need not bother about R.A. at this stage.

Similarly, other bodies which are closer to us and form part of the solar system (such as the sun, moon, and planets) can also be "fixed" in the celestial sphere by Dec., and R.A. The Dec. and R.A. of bodies other than stars, when seen from the earth, will, however, appear to alter daily as the solar system, which is well inside the celestial sphere, revolves against the background of the "fixed" stars.

The question is, how do we find these elusive imaginary spots? Look at Fig. 1.

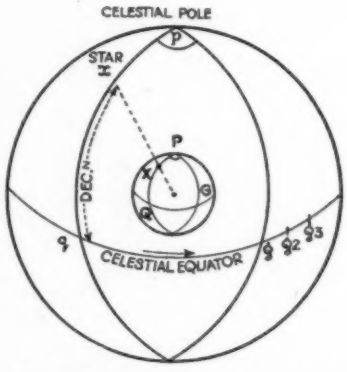


Fig. 1.

The earth's equator and pole, Q and P, have been projected from C, the centre of the earth, on to the celestial sphere at *q* and *p*. Conversely, let us project a fixed star *x* on the celestial sphere, with Declination equal to *qx*, on to the earth. It will cut the earth's surface at X. X is the sub-stellar spot, or G.P. of the star. The *latitude* on the earth of the G.P. will be the same as the *declination* of the star.

Half the deed is now done: we now want to fix the spot X on the earth for *longitude*.

This is a little more difficult (but not much), owing to the rotation of the earth on its axis inside the celestial sphere.

Let us now project the Meridian of Greenwich, G, on to the celestial sphere at *g*. At this moment the longitude of X is GPQ, west of Greenwich, and is the same as the angle *gpq* on the celestial sphere. As the earth revolves towards the west and the celestial sphere stands still, the projection of the Greenwich Meridian will take up positions on the celestial sphere such as g^2, g^3, etc.; and the angle *gpq* will increase: i.e., the *longitude* of X will be continually altering on the earth.

The *longitude* (angle between the Meridians of Greenwich

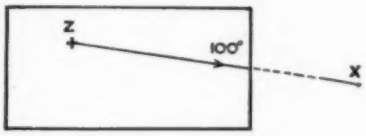
and of the G.P. of the body) is, however, tabulated, at short intervals of time, in the *Air Almanac* as "Greenwich Hour Angle."

Hence, to find the G.P. of X (or of the projection of any other heavenly body catered for in the *Air Almanac*) at any time, all that it is necessary to do is to look up the data given for that instant. We will find the position given as Dec. (Declination) and G.H.A. (Greenwich Hour Angle).

Now we can make use of the imaginary spot by comparing the *Theoretical Distance* of the spot from our D.R. position (this is quite quickly and easily obtainable either by a short mathematical calculation based on data contained in tables, or by quick-working tables, of which there are a large variety) with an *Actual Distance* we find by observing the altitude of the celestial body above the horizon. How the theoretical and actual distances are obtained is explained later.

Suppose our dead reckoning position is "Z" on the chart, and that we are able to *calculate* the distance and bearing of X, *which is off the chart*, from Z. Let us say that we find it is 3,000 nautical miles, and that the bearing is 100°, T. (How to obtain the Calculated Distance is shown later.)

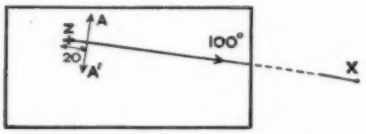
Fig. 2.



From Z draw the bearing, 100°. Suppose, again, we are now able actually to *measure* the distance from where we are to X. And suppose we find it is 2,980 nautical miles, the bearing being the same. (How to obtain the Observed Distance is shown later.) We therefore know that we are (3,000–2,980), or 20 miles nearer X than we thought we were, along the same bearing.

We can then make use of the information on the chart by plotting a position line AA′, at right angles to the bearing, 20 nautical miles nearer or "towards" X on the bearing already laid down.

Fig. 3.

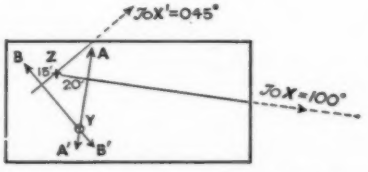


Strictly speaking, the position line should be a portion of the circumference of a "circle of position." As, however, the radius of the circle is large, and we are only dealing with the small portion of it near our D.R. position, there is no appreciable error in making the position line a straight line.

If we have observed only one body, we can lay down only one position line. If, however, we had observed another body, whose G.P. is X′ and which is at a suitable angle from X, and had obtained another position line in the same way, we can obtain a "fix."

Let us assume that the second set of calculation and observation gave us an Observed Distance 15 miles greater than the Calculated Distance, and that bearing was 045°. We are therefore 15 miles away from Z, on that bearing. Plot a position line BB′ at right angles to 045° and 15 nautical miles away from Z. The chart will look as in Fig. 4:

Fig. 4.

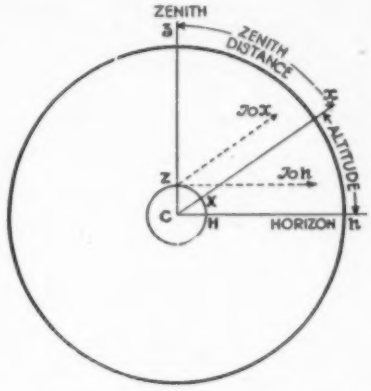


As you know you are somewhere along BB′, and also somewhere along AA′, it follows that where AA′ and BB′ intersect at Y is your position, or "fix." This is, of course, assuming that your original D.R. position Z has not changed much during the interval. If this should be the case, the 1st position line AA′ would need to be transferred.

To obtain the Observed Distance we require a sextant, which, for air navigation work, is used for measuring the angular distance above the horizon, in degrees and minutes, of the body being observed. The horizon may be either natural (with a marine sextant) or artificial (with a bubble sextant).

Let us see how this instrument helps. Going back to the earth and the celestial sphere, let us take a cross-section through any celestial great circle, i.e., a circle whose plane passes through the centre of the earth (Fig. 5):

Fig. 5.



Let x be a star somewhere on the celestial sphere. The observer is at Z, anywhere on the surface of the globe. Immediately above him is the zenith, z, on the celestial sphere. All around z the observer sees the horizon, h, at 90° from z. Somewhere above the horizon is the star x. The celestial great circle passes through z and x and is at 90° to the horizon.

The observer can, with his sextant, measure the altitude of x above the horizon, h, along the celestial Great Circle. As the earth is so small, and the star is so far away, it is exactly as if he were measuring the angle from C, the centre of the earth. The error, Horizontal Parallax, is negligible in practice for all heavenly bodies except the moon, when allowance has to be made. It is quite easy to find the correction in tables, and to apply it.

Hence $x\hat{C}h$ is the Observed Altitude.
Now $z\hat{C}h$ = Zenith to Horizon = 90°.
Then $x\hat{C}z$ = 90° – Observed Altitude.
= Angular distance from x to z.
= Zenith Distance, in degrees and minutes.

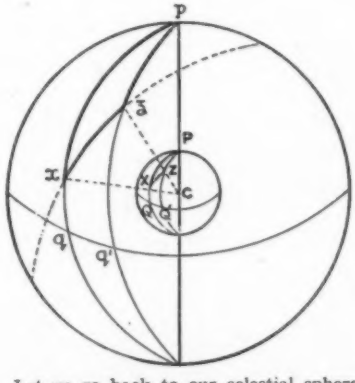
Now look at what is happening on the globe. Z to X, in degrees and minutes, is the same as z to x; Z is where you are, on the surface of the globe; and X is the sub-stellar point, on the surface of the globe. We know that on the surface of the globe 1′ of arc is 1 nautical mile; hence Z to X (or $X\hat{C}Z$ in minutes of arc) is the Observed Distance between yourself and the sub-stellar point X, in nautical miles.

The Observed Distance is usually known as Observed Zenith Distance, or Obs. Z.D. in navigation text-books. The Observed Altitude has to be corrected for some minor corrections such as Index Error, Refraction, etc., depending on the type of sextant used. These, however, are fully explained in any text-book, and are very easy to apply. A variety of correction tables is available for the purpose of finding the necessary correction.

To summarise. By observing, with a sextant, the altitude of the body in degrees and minutes above the horizon, applying small corrections, and subtracting the Observed Altitude from 90°, you have found the Observed Distance in nautical miles between yourself and the sub-stellar point.

How is Calculated Distance obtained?

Fig. 6.



Let us go back to our celestial sphere, our globe, with the observer at his estimated position of Z and the heavenly body at x. As you will see from Fig. 6, the triangle pxz on the

celestial sphere is similar to the triangle *PXZ* on the surface of the globe.

pxq = Celestial Meridian of Star = 90°.
pzq' = Celestial Meridian of Observer = 90°.
qx = Declination of Star, as given in the *Air Almanac*.
q'x = Latitude of Observer.
Then *xp* = 90° − *qx*.
= 90° − Declination
And *zp* = 90° − *q'z*.
= 90° − Latitude.
And *xpz* = Angle between the Meridian of the Observer and the Star.
= Local Hour Angle of Star (L.H.A.).
And *zx* = Zenith Distance.

As the diagram perhaps looks rather complicated, let us go to the surface of the globe, and stay there (Fig. 7). Putting in the Greenwich Meridian PG, what do we find?

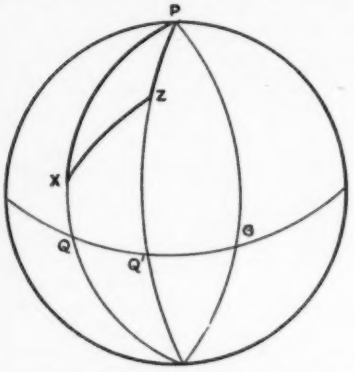


Fig. 7.

(*a*) We know the angle GPQ; this is the Greenwich Hour Angle tabulated in the *Air Almanac* for X.
(*b*) We know the angle GPQ'; this is the longitude (W, in this case) from Greenwich of the Observer at his estimated position Z.
(*c*) Hence, by subtracting one from the other (they are each in degrees and minutes) we know, Q'PQ or the Local Hour Angle of X, or ZPX.

We have now a spherical triangle PXZ of which we know two sides, PX (90-Dec.) and PZ (90-Lat.) and the included angle ZPX. We must find the third side ZX (the Zenith Distance) and also the angle PZX, from which we shall obtain the bearing of Z to X.

It may sound complicated to "solve a spherical triangle" in order to find ZX and PZX. People start to be frightened at the mere sound of the words "spherical trigonometry." However, even if ZX is found the "long" way of logarithms, it is only a question of knowing how to use a short formula, and of being able to look up a few statements in books of tables, put them down on paper, and add up three short lines of figures—at the most. With a little practice, the procedure becomes automatic. A deep knowledge of spherical trigonometry is not required to be able to look up tables and add together a few figures. Actually, there are in existence over a dozen "short" methods, all evolved with the object of cutting out even this small amount of work.

To find ZX, then, becomes merely a matter of "inspection" of the special tables developed for these "short" methods with the known "arguments" of Declination, Latitude, and Local Hour Angle. It can be done in a couple of lines, and in less than a couple of minutes.

The bearing PZX (or Azimuth) is similarly found by the use of Azimuth Tables, in one opening of the book.

To summarise:

(1) To find the Calculated Distance, usually known in text-books as the Calculated Zenith Distance, or Calc. Z.D., you must make use of the following "arguments":

(*a*) The Local Hour Angle of the body (found by applying the longitude of your D.R. position to the Greenwich Hour Angle given in the *Air Almanac* for that time).
(*b*) The Declination of the body (given in the *Air Almanac*).
(*c*) The D.R. latitude (which you give yourself).

How you make use of these three "arguments" is a matter of choice. The Calc. Z.D. can be found either by "long" (i.e., logarithmetic) methods or by "short" methods (i.e., looking up special tables designed to cut out logarithms).

In any case, finding the answer should not take more than two or three minutes.

(2) To find the Azimuth, or bearing: Look up Azimuth Tables, with the same three "arguments." Time required—less than one minute.

(To be concluded next week.)

HENSCHEL PRODUCTION

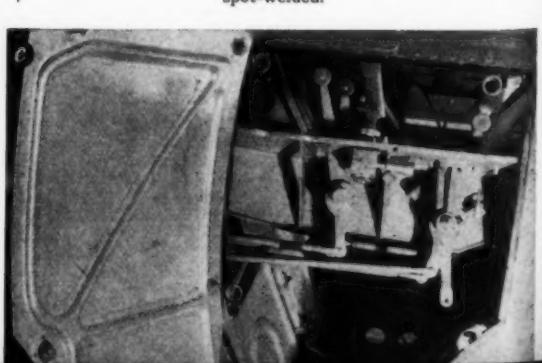
German Use of Pressings and Castings

THE Henschel Hs126 parasol general purpose military monoplane is being produced in very large quantities in a very short time, due to the pressing of most of the sheet metal parts and the extensive use of castings. There are about 3,000 sheet metal parts, of which 1,000 are pressed in dies.

The fuselage comprises transverse frames of sheet metal and heat-treated Elektron castings. The frames are formed on a machine designed by the manufacturers; this is quite automatic and is fitted with accurate steel templates. It is not influenced by the operator's skill and its capacity is 30 frames an hour. The covering is pressed sheet metal. The main frames for the attachments of the wings, the controls and the engine are pressed solid members of sheet metal, with cast heat-treated bridges secured by screws with elastic stop-nuts.

The two halves of the undercarriage are cast integral with each other and a cast-steel journal is screwed to the ends of each half. There are more than 400 light metal castings in the machine. All wing ribs are die-pressed.

(a) Forming the transverse frames on an automatic machine.
(b) Pressing wing ribs in a 1,000-ton hydraulic press.
(c) Showing the use of pressings and forgings. The door is spot-welded.



AIRCRAFT MATERIALS

Part II: Dr. Gough's Lecture Continued: Extruded Sections: Plastics and Compressed Wood: Hollow Bakelite Airscrews

To avoid confusion, the original figure and table numbers have been retained in this precis of the lecture

THE remarkable changes which had been made during the last twenty-five years in the construction of aircraft had been greatly assisted by the improved constructional materials that had been made available. For many years wood, covered with fabric, was the principal constructional material, and in many ways it was still satisfactory. It was easily worked and the strength characteristics were generally very reliable. For use as a stressed covering, wood, however, suffered from the low shear modulus. Dr. Gough pointed out that the Short Silver Streak was the first all-metal machine to be produced in this country, and was built in 1919. The new Short Empire flying boats were a straight development from the Silver Streak.

TABLE VI.

MECHANICAL PROPERTIES OF SOME REINFORCED SYNTHETIC RESINS.

Reference.	General Description.	Density. lb./ft³	Tension		Compression Max. Stress lb./in²	Shear	
			Max. Stress lb./in²	E. lb./in² × 10⁻⁶		Max. Stress lb./in²	N. lb./in² × 10⁻⁶
A	Fabric Reinforced. Square Weave... ...	84.4	10,000	1.07	26,600	6,500	0.35
		83.2	10,300	0.77	25,030	8,150	—
		85.5	12,080	1.21	27,570	10,600	—
		84.0	16,200	1.43	—	10,500	0.36
		83.1	18,000	1.53	23,000	6,500	—
		75.3	26,350	1.80	—	—	0.39
		85.5	28,600	1.81	—	10,600	0.45
	Cord Reinforcement	86.2	23,000	5.9	15,200	3,680	—
		84.4	27,500	1.81	27,000	6,500	0.30
		84.4	35,000	6.9	25,000	5,000	—
	Fabric and Cord Reinforcement	85.6	28,600	1.8	—	7,960	—
	Bonded Paper (Plane of Sheet: long. dir.)	84.7	12,150	1.25	—	—	—
	(Plane of Sheet: trans. dir.)	84.7	23,000	2.4	—	—	—
B	Cord Reinforcement	84.0	35,000	3.5	25,000	6,000	—
		88.0	37,000	5.2	18,000	5,000	—
		90.6	55,000	5.8	23,550	—	—
		87.3	69,400	7.5	—	2,000	—
C	Impregnated Cellulose Fluff	86.9	22,000	2.1	22,500	7,000	—

The relative merits of steel and light alloys involved a consideration of the external form of the desired structure. In a biplane one might prefer all-steel construction. Careful design had made possible the use of thin high-tensile steel strip in which very high stresses could be developed.

The evolutions which had occurred through changes in the materials used were illustrated by a slide, which is reproduced in Fig. 28. (A) is a common form of spindled spruce spar of "I" section. The change-over to thin steel strips introduced some complicated designs, of the general form shown in (B). The use of rolled section in light alloys permitted a reversion to the plain "I" section shown in C.

The change-over to thick-winged monoplane construction facilitated the use of the stressed-skin type of wing. In a thin wing such as that of a biplane the torsion load had to be resisted mainly by differential bending of the front and rear spars. In a thick wing it was possible to use a box form of construction to carry the torque. The use of thin sheet metal in compression or in shear raised problems of stability similar to those which arose in connection with the built-up steel-strip spar. The majority of aircraft fuselages now constructed failed under test by some form of instability in compression or shear. The stress which would cause buckling in the sheet was, in general, proportional to the elastic modulus of the material, to the square of its thickness, and varied inversely as the square of the minimum free width. Thus, if superficial dimensions and weight of structure were fixed, the light material was the better. In a monocoque fuselage no real advantage could be taken of any improvement of strength of the material above the buckling stress. What was required was a material having a lower density. In the wing, on the other hand, whether a spar or a box form of construction was used, instability could usually be avoided, and in that case full advantage could be taken of any increase in the intrinsic strength in the material.

The important development of the production of extruded sections in light alloys had largely led to the replacement of rolled and drawn sections. Some typical examples and applications are reproduced in Fig. 16. The lecturer expressed the view that the outstanding feature of the light alloy all-metal aircraft of to-day was the use of extruded sections. With present facilities no difficulty was seen in producing aircraft weighing 70 to 80 tons. Such a machine would be of about 180ft. span and have a length of about 140ft.

As an example of modern wooden construction the lecturer quoted the De Havilland Albatross, in which the fuselage consists of two sheets of three-ply separated by a layer of balsa wood. In the wing covering also, which consists of two layers of spruce planking laid on diagonally at an angle of 90 deg. to one another, the stability was such that under test a stress was developed nearly up to the ultimate compressive stress of the laminated spruce skin before failure occurred.

Much development work was in progress on the application of reinforced timber for structural purposes. The material consists fundamentally of laminations, with or without previous impregnation and with or without fabric inserts, cemented together under pressure. The resulting specific gravity ranged from about 0.8 up to about 1.4. These materials showed to advantage under pure compression, the ultimate strength being higher in proportion to the specific gravity than those of aluminium and steel alloys. On proof stress they did not show up quite so well. Table VIII compared the average properties of a high-grade material with one of the best raw aluminium alloys available.

For the purpose of monoplane wing construction reinforced timber was well adapted to take bending loads. For the spar booms highly compressed timber was suitable, but for the skin timber of lower specific gravity was best.

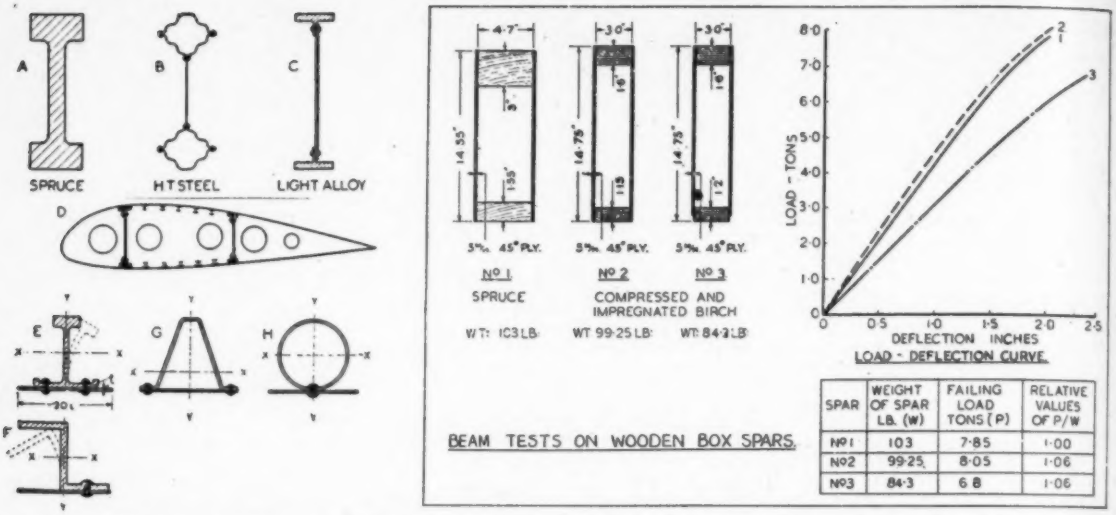
An interesting experimental development of the separated skin construction used in the Albatross fuselage was the replacement of the balsa wood by vulcanised expanded rubber. This material is very light and free from moisture absorbtion. In

TABLE VIII.

GENERAL COMPARISON OF A HIGH-GRADE REINFORCED TIMBER AND A HIGH-TENSILE ALUMINIUM ALLOY.

	Reinforced* Timber.	Al. Alloy.
Specific Gravity (S.G.)...	1.4	2.8
0.1% Proof Stress (P.S.) tons/in²	10.5	28
U.T.S. tons/in²	20	33
Young's Modulus (E) lb./in² × 10⁻⁶	4	10
Shear Modulus (G) lb./in² × 10⁻⁶	0.25	4
Ratios:		
P.S./S.G.	7.5	10
U.T.S./S.G.	14.3	11.8
E./S.G.	2.9	3.6
G./S.G.	0.18	1.43

* Note.—These figures are conservative.



SPAR	WEIGHT OF SPAR LB. (W)	FAILING LOAD TONS (P)	RELATIVE VALUES OF P/W
No 1	103	7·85	1·00
No 2	99·25	8·05	1·06
No 3	84·3	6·8	1·06

Fig. 28 (left) shows development of wing spar sections (A, B, C). D is a typical monoplane section, E a stringer of efficient form, F a poor design of stringer, G an asymmetrical section, and H a tubular stringer (R.A.E.). Fig. 31 (right) shows a comparison of a wooden and two compressed and impregnated birch spars, with their load-deflection curves.

an experimental wing section of this type of construction a very good strength-weight ratio had been obtained under test. Failure did not occur until a stress of approximately 4 tons per sq. in. had been attained. This stress, incidentally, was calculated only on the ply and not on the separating material.

It might occur that in the wing section the depth of the spar was fixed, but any economy in spar width without sacrificing strength was an advantage. Some experimental results were of interest. Three hollow box spars, each 16ft. in length, were made up. The cross-sectional dimensions are shown in Fig. 31. The booms of one spar were ordinary spruce, those of the others being of different types of impregnated and compressed laminated birch. Each spar was tested to destruction as a simply supported beam over a span of 14ft. 6in. with a centrally applied load. The load-deflection curves obtained are reproduced in Fig. 31, while the inset table shows that marked economy of beam width and a small saving of spar weight could be obtained without any sacrifice in the total load-carrying capacity of the beam.

Turning to the subject of plastic material, the lecturer said that, from the structural point of view, a plastic material should have a strength-weight ratio substantially equal to that of steel, light alloy or wood, based on tensile or compressive strength, whichever was the lower. About ten months ago, he said, a description was published in *Flight* of a new type of wing primarily designed for construction in plastic material. At that time no decision had been taken regarding the choice of plastic materials to be used, but the choice had now fallen on a special material made from a cellulose fluff impregnated

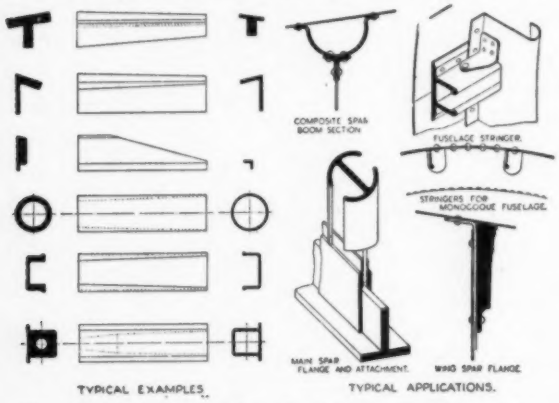


Fig. 16. Typical examples of extruded aluminium alloy sections and some applications.

TABLE IX.

SPECIFIC PROPERTIES OF ALUMINIUM ALLOY, REINFORCED TIMBER AND PLASTIC MATERIAL.

Material.	P. Stress.	Ratios. U.T.S.	E.
	Sp. G.	Sp. G.	Sp. G.
Al. Alloy	10	11.8	3.6
Reinforced Timber	7.5	14.3	2.9
Plastic Material	4	6.4	1.4

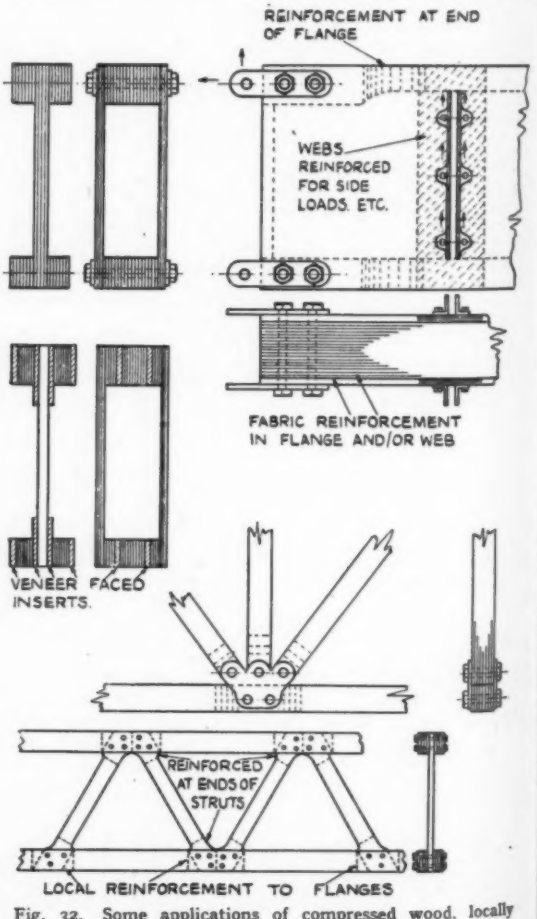

REINFORCEMENT AT END OF FLANGE
WEBS REINFORCED FOR SIDE LOADS, ETC.
FABRIC REINFORCEMENT IN FLANGE AND/OR WEB
VENEER FACED INSERTS.
REINFORCED AT ENDS OF STRUTS
LOCAL REINFORCEMENT TO FLANGES

Fig. 32. Some applications of compressed wood, locally reinforced against shear.

with a phenolic resin which could be moulded into the required form under a pressure of 2 tons per sq. in. at 150 deg. C. A comparison between the specific properties of aluminium alloys, reinforced timber and plastic material is given in table IX.

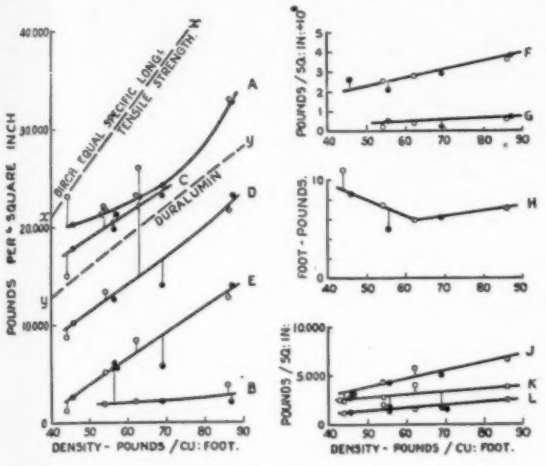

BIRCH EQUAL SPECIFIC LONG: TENSILE STRENGTH
DURALUMIN
POUNDS PER SQUARE INCH
DENSITY - POUNDS / CU: FOOT.
POUNDS / SQ: IN: ÷10
FOOT - POUNDS.
POUNDS / SQ: IN:

Fig. 18. Tests on laminated compressed and impregnated wood. A, ultimate tensile, longitudinal; B, ultimate tensile, transverse; C, modulus of rupture in bending; D, compressive strength, longitudinal; E, compressive strength, transverse; F, Young's modulus (E), longitudinal; G, Young's modulus, transverse; H, notched bar impact; J, shear strength, longitudinal parallel to laminations; K, shear strength, longitudinal transverse to laminations; L, shear strength, transverse parallel to laminations.

Dr. Gough stated that complete designs had now been prepared for a single-engined aeroplane weighing 5,750 lb., and a twin-engined machine weighing 10,000 lb. The development of aircraft of moulded material of this type might prove to be the forerunner of a revolutionary step in aircraft design and in the use of a new material.

When dealing with the subject of airscrews, the lecturer stated that at the present time the position regarding the most suitable material was in an extremely interesting state of uncertainty and change. Many years ago airscrews were almost universally constructed of timber. Ten years ago, probably 90 per cent. were still of wood and few were of steel and aluminium alloys. To-day probably 50 per cent. were of wood, 45 per cent. of aluminium alloys and the remaining five per cent. of compressed and laminated wood, steel or magnesium alloys.

TABLE X.

THREE-BLADED AIRSCREWS DESIGNED TO ABSORB 1,600 H.P. AT 2,750 ENGINE R.P.M. DESIGN SPEED, 250 M.P.H. AT 10,000 FT.

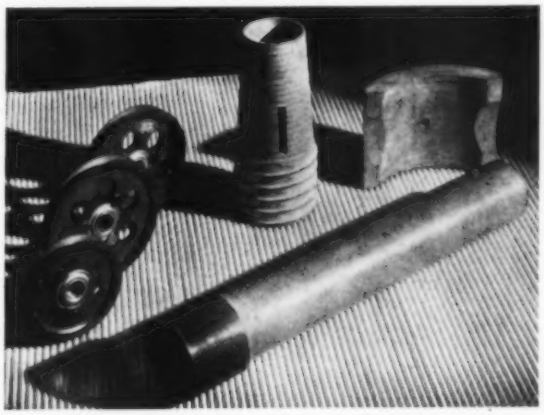
Blade Material.	Gear Ratio.	Diameter of Airscrew, ft.	Blade Root Diameter, in.	Design Stress in Blade, tons/in.²	Centrifugal Load, tons.	Weight of Hub, Shell, lb.	Weight of Blade, lb.	Weight of Complete Airscrew Assembly, lb.
Magnesium Alloy	.500	12½	6.0	4.5	49.5	52	78	419
	.500	12½	5.5	6.0	40.6	47½	64	352
Aluminium Alloy	.500	12½	5.5	7.7	53.0	53	93	474
	.500	12½	4.7	11.0	49.5	44	87½	425
Laminated Wood with Compressed Root...	.500	11½	6.7	—	18.2	41½	46*	275
	.444	12½	6.6	—	20.0	41½	57*	308

* Including steel sleeve at root.

The most profound influence of all in the construction of airscrews came from the introduction of the variable-pitch airscrew. The problem of holding wooden blades securely at the root under big centrifugal loads was too difficult, and in the meantime aluminium alloy forgings had been so greatly improved that the metal became supreme for variable-pitched airscrew blades. The advantages of the much lighter magnesium alloys had not been overlooked and great advance had been made. Magnesium alloys suffered from certain serious disadvantages, but much success had been attained in overcoming these. He estimated that about one hundred modern magnesium airscrews were flying or had flown in this country. Screws of this material were now in active commercial production and had an assured future.

Comparatively recently a powerful new entrant had arisen in the airscrew field. This was the screw made of laminated impregnated and compressed wood. By ingenious manufacturing processes airscrew blades could be made having properties, proportional to the stress at any point. The lightness of ordinary wood could be approached in the blade while the necessary increased resistance to shear and tension could be attained at the root. This type of airscrew had emerged successfully from the experimental and development stage and was in commercial production. It was estimated that between 30 and 40 airscrews, that is to say about 100 blades, of compressed wood were flying in this country, and had between them a maximum flying experience of about a thousand hours.

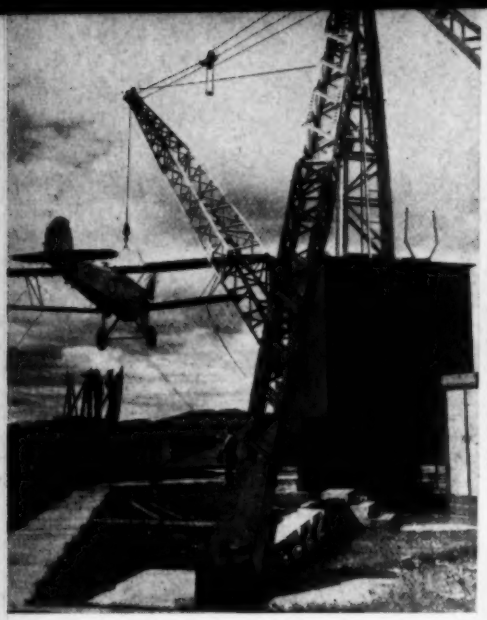
With reference to airscrews made of reinforced synthetic resin, the lecturer stated that perhaps the best example of recent experimental development was the hollow moulded blade. An experimental screw of this type (exhibited at the lecture) was probably the largest moulding yet made in which continuous lengths of fabric in cord or sheet form had been used. The threads at the root end were unbroken throughout the whole length of the blade, except where cut away when gradually reducing the cross section. At the root these cords followed the surface contour in a manner similar to the grain flow in a well-designed metal airscrew. The reinforced material gave a tensile strength of 35,000 lb./ sq. in. The manner in which the hollow airscrew blade was made was interesting. A core of fusible metal was accurately located in the centre of the blade around which the reinforced material was moulded and compressed. The core was subsequently removed by the use of a high-frequency induction furnace and without causing damage to the plastic material. Each blade was 78in. long forming a 13ft. 6in. diameter airscrew. A complete blade was made in eight hours. The weight of each blade was 52 lb. before trimming, compared with 65 lb. for the equivalent blade made of metal. The lecturer emphasised that this development was purely experimental. It was being undertaken by a well-known firm of aircraft manufacturers. (Actually, De Havillands—ED.)



Plastics in aircraft construction. These pulleys, the chafing ring, the barrel support, and the undercarriage piston in the foreground, are machined from Bakelite laminated material.

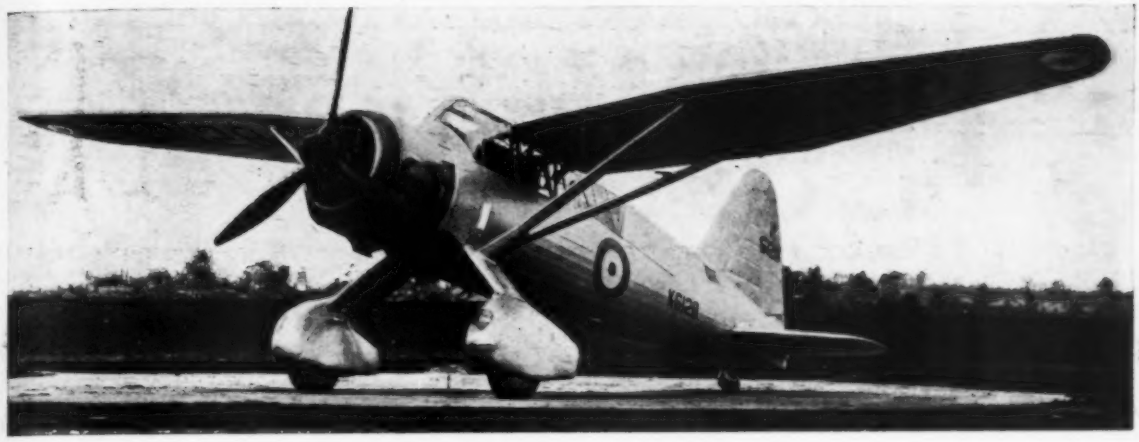
The lecturer stated that speculation regarding the future of airscrew materials would be unwise as so many factors were involved. It was certain that engines of 2,000 h.p. would be available fairly soon. Large powers would in general mean large diameters and owing to the large increase in weight associated with increase in diameter, the need for the lightest possible material would become urgent. The lecturer thought that it seemed probable that in five years' time airscrew practice might be represented by 70 per cent. of airscrews made in aluminium alloys, 20 per cent. in compressed wood and 10 per cent. in magnesium alloys. In ten years' time they might see a real fight for supremacy between metals and non-metals for airscrew purposes.

At the conclusion of the lecture a tribute was paid to Prof. Gough by Mr. Handley Page, who was in the chair, and by Mr. D. R. Pye, Director of Scientific Research at the Air Ministry. The latter made the interesting disclosure that the Royal Aeronautical Society had, as he put it, "Caught Dr. Gough just in time" as he would be leaving soon to take up the new post of Director of Scientific Research at the War Office.



EMPIRE AIR DAY ECHOES

Some varied shots by *Flight* camera-men. Above are (left) a Hawker Osprey being loaded on to the catapult at Leuchars and (right) an Avro Tutor loaded with eager humanity at Kenley. The stop-butts scene is also at Kenley ; the machine that is firing is a Gloster Gauntlet. Below is the Miles Nighthawk in which Capt. Balfour, Under-Secretary of State for Air, toured a number of stations. At the foot of the page is the Short Sunderland, which appeared at Felixstowe ; it is seen on the "production line" at Rochester.



A Lysander in pre-camouflage colourings.

FOR ARMY CO-OPERATION

Full Details of the Westland Lysander Mark I : Noteworthy Constructional Features : Remarkable Servicing Facilities

BOTH aerodynamically and structurally, the Westland Lysander Army Co-operation monoplane, which it is now permissible to describe in detail, is one of the most interesting machines produced in recent years. For army co-operation work it is essential that both the pilot and the observer should have as good a view as possible in a forward and downward direction, and this consideration has led to the adoption of the high-wing arrangement. It can also be said that it was this consideration of view which suggested a strut-braced monoplane as distinct from a cantilever one. Obviously it would be very difficult to support a cantilever wing at the extreme top of the cockpits where the width available is comparatively small.

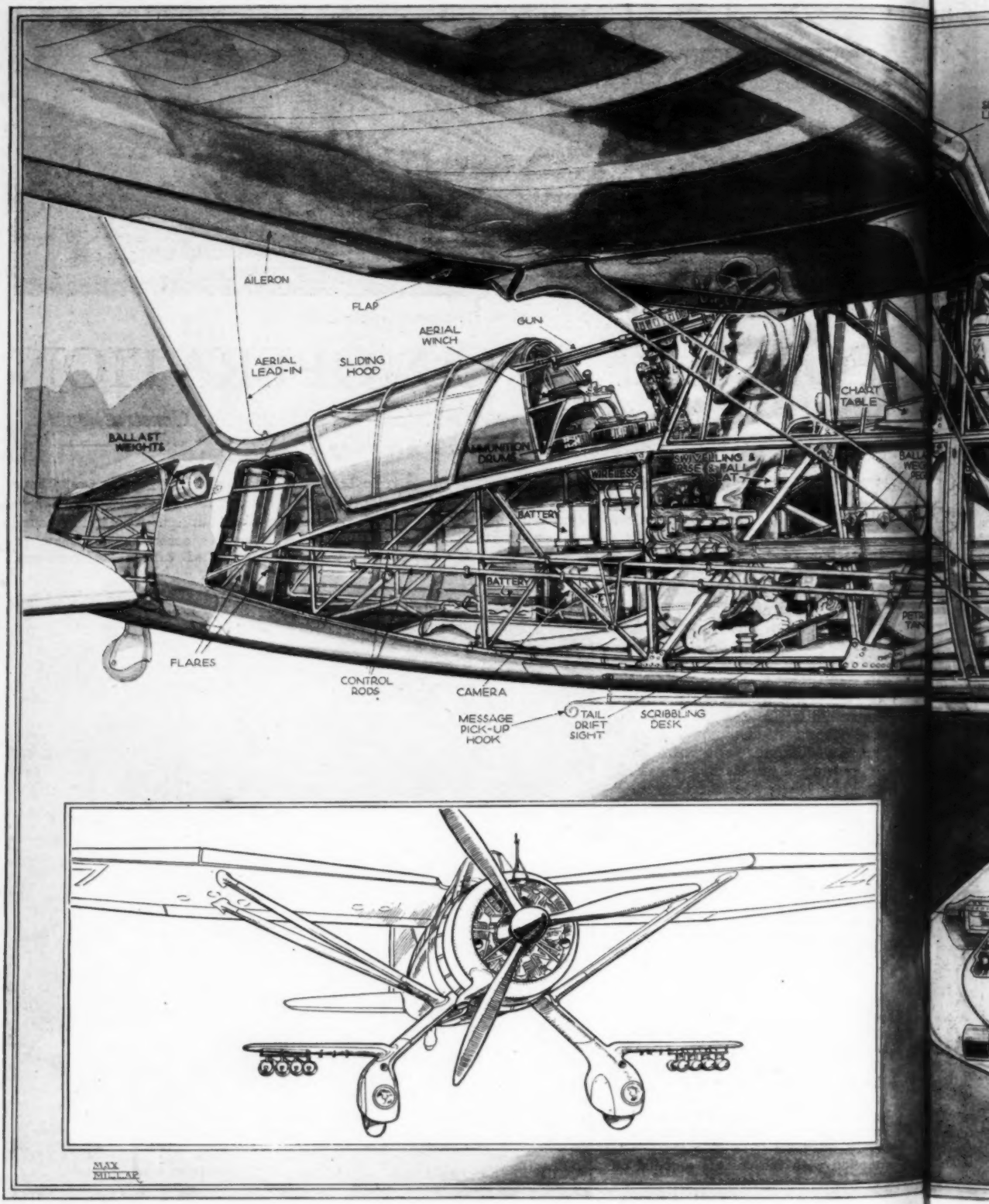
An indirect result of the use of a high-wing position is traceable in several directions of the design. For example, a retractable undercarriage would be almost unthinkable in a wing arrangement of this type, and consequently the problem arose how to arrange the undercarriage. The conventional type, consisting of a tripod of which two members were attached to the fuselage and the telescopic leg to the wings, would have been somewhat cumbersome and also heavy. Ultimately a most unorthodox type of undercarriage was evolved by Mr. W. E. W. Petter, who has been largely responsible for the design of the Lysander. This undercarriage member is shaped like an inverted U, and is in the form of an aluminium alloy extrusion of roughly rectangular section with the corners rounded off.

It is doubtful if this type of wheel support would have been adopted but for the fact that it was decided to place the machine guns in the wheel fairings. Also, if it is desired to carry bombs, the Lysander accommodates them on small stub wings simply bolted to the undercarriage.

"Flight" photograph.

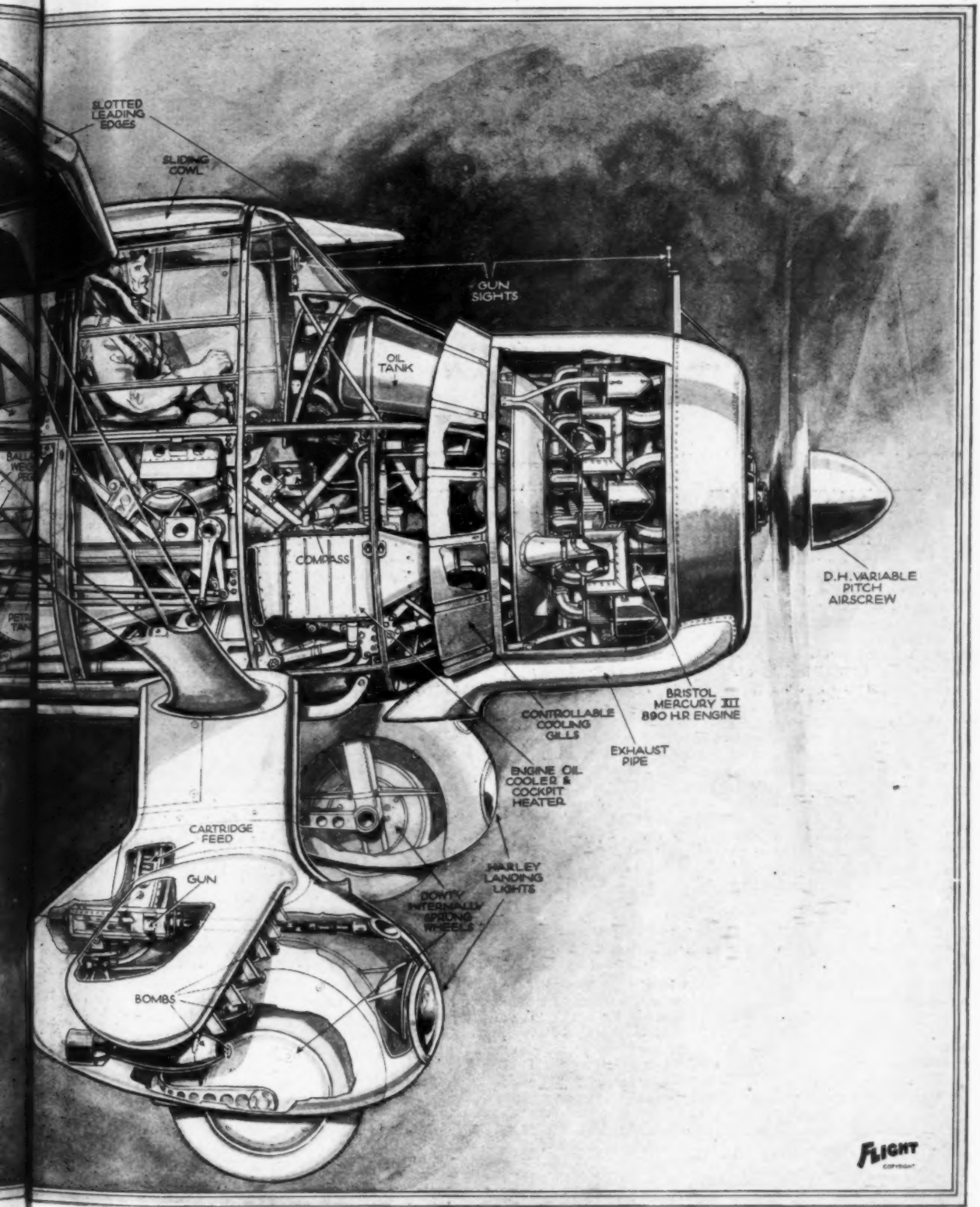
The Lysander does a zoom. In spite of the steep angle the lift slots are but slightly open, and the flaps are only down a few degrees.

AN OUT-of-the-ORDINARY MILITARY AEROPLANE : THE WEST

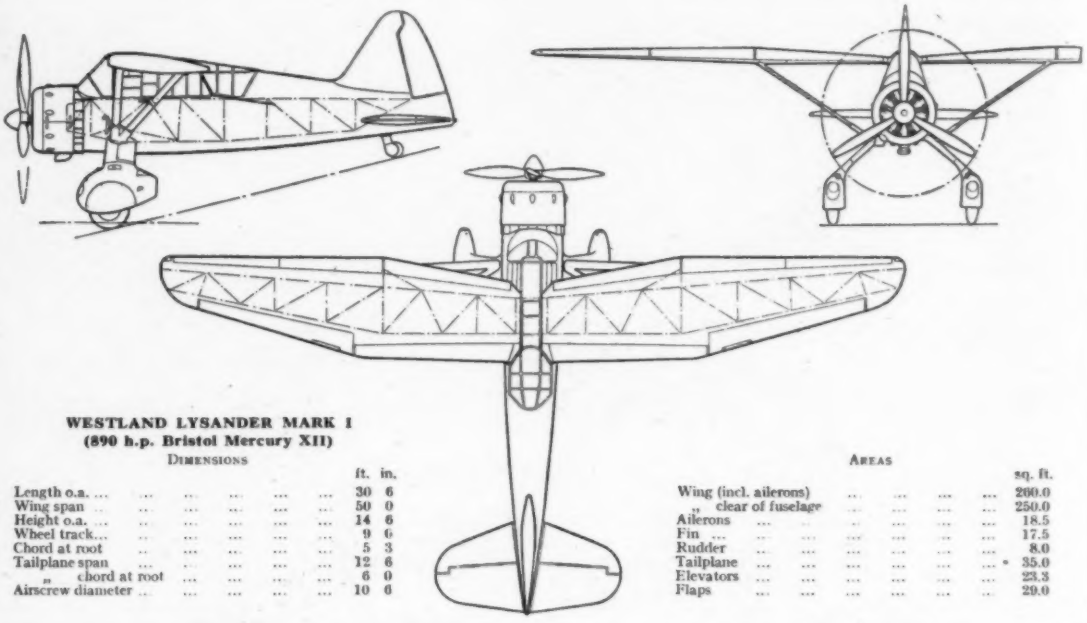


A refreshing change from the orthodox low-wing monoplane, the Westland Lysander is a fine example of design for a specific purpose—in this case, army co-operation. Its duties include message dropping and pick-up, artillery co-operation, photography, low bombing and machine-gunning, photographic equipment, bomb racks and gun stubs. A future version—the Mark II—will have

THE WESTLAND LYSANDER ARMY CO-OPERATION MONOPLANE



...case, army co-operation. Among its duties, which will mainly be performed at low altitude, are general liaison work with bodies of troops on the ...artillery co-operation, and transport of executive officers. The inset shows the frontal aspect, and the arrangement of the bombs on the detachable ... will have the sleeve-valve Perseus engine.



WESTLAND LYSANDER MARK I
(890 h.p. Bristol Mercury XII)

DIMENSIONS

	ft.	in.
Length o.a.	30	6
Wing span	50	0
Height o.a.	14	6
Wheel track	9	6
Chord at root	5	3
Tailplane span	12	6
„ chord at root	6	0
Airscrew diameter	10	6

AREAS

	sq. ft.
Wing (incl. ailerons)	260.0
„ clear of fuselage	250.0
Ailerons	18.5
Fin	17.5
Rudder	8.0
Tailplane	35.0
Elevators	23.3
Flaps	29.0

When these considerations are taken into account, the adoption of this type of undercarriage, which would otherwise be rather puzzling, becomes quite logical.

From the aerodynamic point of view, the Westland designers deserve the very greatest credit for having produced a fully slotted and flapped wing in which all operation is entirely automatic. The Handley Page leading-edge slots extend over the entire span of the wings, the inner portion being a lift slot, while the outer portion is a normal tip slot. The inner slot is connected by levers and linkages to the trailing-edge flaps. By very careful design the arrangement has been so adjusted that by a suitable choice of take-off attitude the pilot can cause the lift flaps to come down the desired number of degrees. If he lifts the tail more during the take-off, the machine will run along without the slots opening or the flaps coming down, whereas if the tail is kept lower than desired the slots and flaps will open fully, and the drag will be greater than desirable, so that probably the take-off run will be increased. Similarly, on landing: by dropping the tail sufficiently the leading-edge slot automatically brings the flap down to its full extent, which results in the steepest approach and shortest landing run.

No Snag

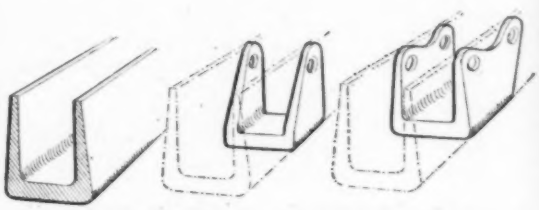
It might have been thought that as the leading-edge slot is, so to speak, incidence-operated, it might be possible, in pulling the machine out of a steep dive, for example, to cause the slot and flap to open at high speed. This, however, has not been found to be the case, presumably because in a pull-out from a dive, the machine does not reach an angle of incidence sufficiently great to cause the slot to open.

Older readers of *Flight* will doubtless recollect the little Widgeon monoplane built for one of the Lympne light plane competitions and afterwards bought by Dr. Reid. That little machine was also a strut-braced monoplane, and its plan form was very much like that of the modern Lysander monoplane. This is not, of course, any mere coincidence, but is due to the fact that on the one hand it is not desired to have a wide chord at the fuselage, and on the other that the maximum wing strength is desired at the point where the lift struts are attached. Consequently, in plan form the chord is greatest along the line joining the lift strut attachments to the wing, and the wing tapers outward and inward from this line.

The fuselage of the Lysander has the usual girder type of construction, but the external shape is made rounded by the addition of a light fairing of wood construction clipped to the metal fuselage primary structure. Generally speaking, the fuselage is of good shape from a drag point of view, although the fact that it was desired to place the pilot high above the fuselage in order to give him a good view has somewhat interfered with what would otherwise be a very nearly perfect streamline shape. That the drag cannot be excessive is proved by the fact that the Lysander Mk. I, when fitted with a Mercury XII engine of 890 h.p., has a top speed of about 230 m.p.h. The landing speed is 52 m.p.h., the wide speed range being attained very largely by a combination of high-wing loading and the use of slots and flaps.

From a structural point of view, also, the Lysander is rather unorthodox. To sum it up quite briefly it might perhaps be said that the outstanding feature in its construction is the very extensive use of extruded sections of light alloy. There has been very close co-operation between the Lysander's designers and two specialist firms, High Duty Alloys, of Slough, and the Reynolds Tube Co., Ltd.

Accessibility and ease of maintenance and servicing were the guiding principles in deciding upon the general type of construction. That solved the problem, "girder or monocoque?" There still remained the details. Ultimately it was decided to use in the front portion of the fuselage the type of construction of which the Westland firm had such long and successful experience in the Wapiti and Wallace biplanes: duralumin tubes of square section joined by bolts and flat plates. For the rear portion,



Straight and sloping forked lugs are cut from special channel-section extrusions.

however, it was decided to use seamless steel tubes, joined by welding. Not only is this form of construction quick in production, but the steel tube is economical in weight when lightly loaded, so that thin gauges can be used. Also, it is very easy to fasten brackets to it by bolts or clips. Thus, the fuselage is in two separate units, joined together by bolts and flat plates.

Clever use has been made both in the fuselage and wing of a few standard channel sections, produced by extrusion. Whenever a forked plate is wanted it is cut from a length of these extruded channels, the cut being varied according to the angle of the forked plate desired. The whole thing is delightfully simple and much quicker than making up forks from sheet steel, which has to be bent, nibbled, drilled and very often bushed.

In the construction of the wing, extensive use has also been made of extruded sections. The main "theme" of the wing is a very substantial front spar, metal-covered leading edge, a light tubular rear spar and fabric covering from front spar to trailing edge.

The front spar is built up of two T-section flanges joined by a flat sheet web. The flanges start life as extrusions of "bowler-hat" section. They are then machined on a special Kendall and Gent planer-miller to the desired T-section, leaving the original section almost intact at points where bolt attachments are required. The planer-miller machines four flanges in one operation. The percentage of metal cut to waste is rather high, but against that must be set the simplicity with which attachments can be made to the extruded sections, and the waste itself has a considerable value.

Two contrasting impressions of the Lysander by a *Flight* photographer. The lower view clearly shows the why and wherefore of camouflage.

The lift struts are also of extruded light metal. The section is an H, and the struts are tapered towards the ends by cutting away some of the web, bending the flanges towards one another and joining them together by a narrower sheet-metal strip. The whole is then faired.

The fabric which covers the rear portion of the wing is attached to the front main spar flange by a metal strip and small screws with Simmonds elastic stop nuts. A narrow strip of the fabric is doubled back over the metal strip and covers it.

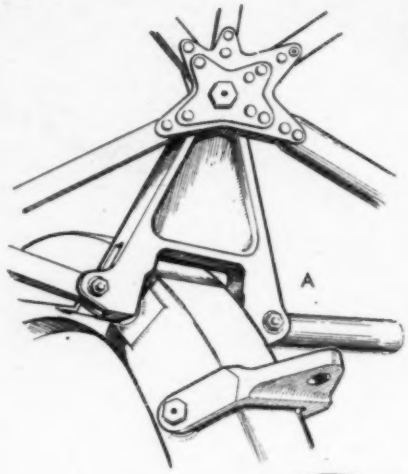
Reference has already been made to the unusual undercarriage. The inverted U-tube at first appears an expensive way of carrying the Dowty internally sprung wheels, but, in addition to taking the weight of the entire aircraft, this tube also carries the two machine guns and the lift strut attachments, so that it serves many purposes.

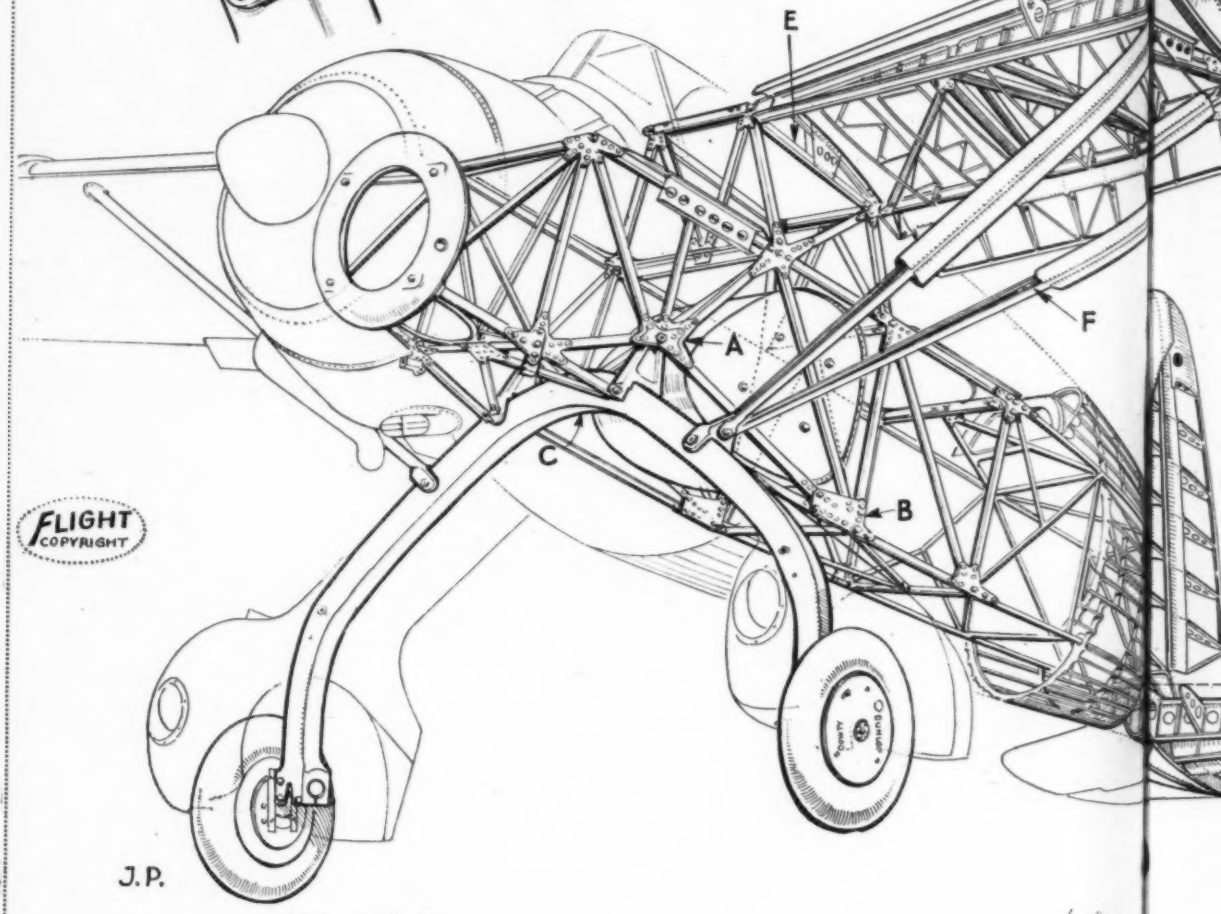
The Bristol Mercury XII engine is enclosed in a long-chord cowl with controllable gills for adjusting the cooling. The De Bergue riveted fuel tank, of 95 gallons capacity, is carried in the fuselage, just behind the pilot's seat. The airscrew is a three-bladed De Havilland controllable pitch.

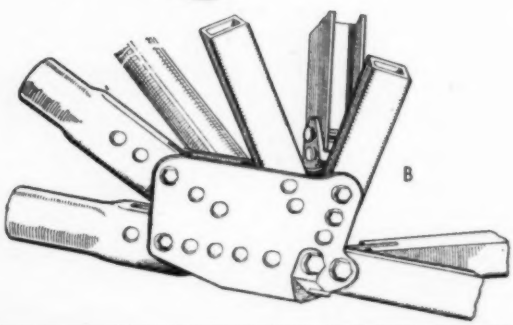
Designed as it is for Army co operation, the Lysander carries very complete equipment, including electrical, wireless, photographic and navigational gear, parachute flares and

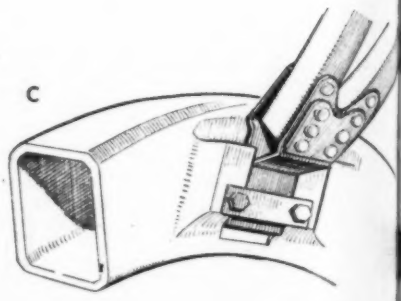
SOME CONSTRUCTIONAL DETAILS

The inverted U-tube of the undercarriage (A) is carried on a triangular forging. The lift struts are attached by the fork seen just below this forging. The rear fuselage portion is of welded-steel-tube construction, while the front portion is mainly of square duralumin tubes, joined as at B. The undercarriage tube is free to flex in a vertical plane but prevented from moving laterally by the arrangement shown in C. The leading-edge ribs of the wing are of the same type of construction as those of the tailplane (D). Details of front and rear spar construction, and drag bracing are seen at E. The lift struts (F) are H-section extrusions with fairings. G shows drag members and their attachments at the point on rear spar where the lift strut is attached.

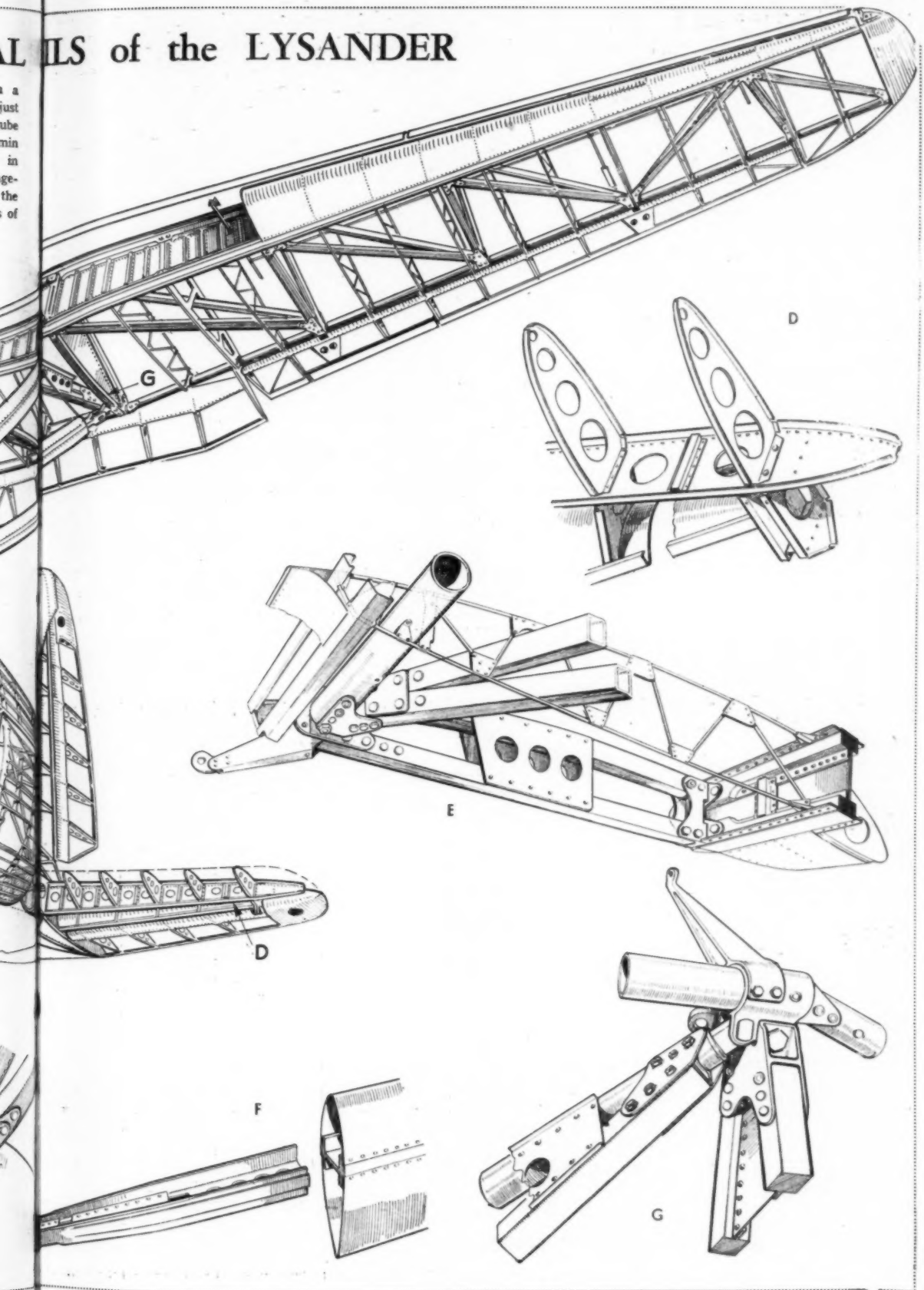








ILS of the LYSANDER



oxygen. It has, of course, the hook under the fuselage for picking up messages.

The standard armament consists of three machine guns, two of them in the wheel fairings and a Lewis gun for the observer. As already mentioned, when used as a bomber, the machine carries the bombs on two small stub wings bolted to and easily removable from the undercarriage U-tube.

One very great advantage of the unusual placing of machine guns and bombs is the remarkable accessibility. "Bombing-up" and machine-gun adjustments and inspection can be carried out conveniently, as the height above the ground is but two or three feet. The Service will appreciate this feature when in the field.

With an empty weight of 4,065 lb. and a disposable load of 1,855 lb., the Lysander has a gross weight of 5,920 lb. When fully loaded it has the following speeds:—

Sea level	206 m.p.h.
5,000ft.	220 ,,
10,000ft.	229 ,,
15,000ft.	223 ,,
20,000ft.	212 ,,

The minimum flying speed (engine on) is 55 m.p.h., and the landing speed 52 m.p.h. It will be appreciated that a speed range of 4 : 1 is very remarkable.

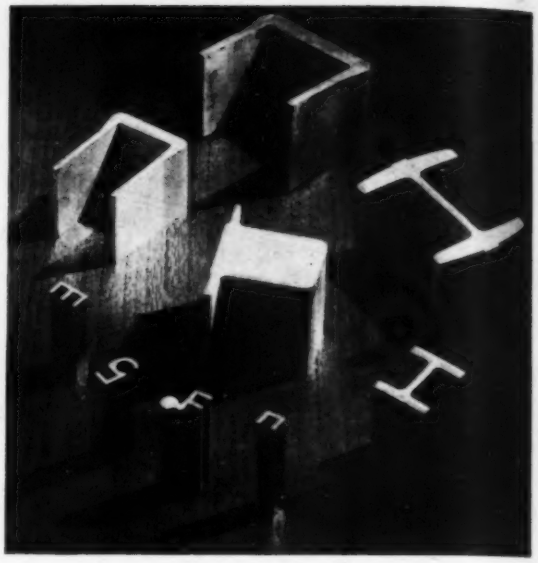
The sea level rate of climb is 1,650ft./min., and the different altitudes are reached as follows:—

5,000ft. in 3.1 min.	15,000ft. in 11.4 min.
10,000ft. in 6.8 ,,	20,000ft. in 19.5 ,,

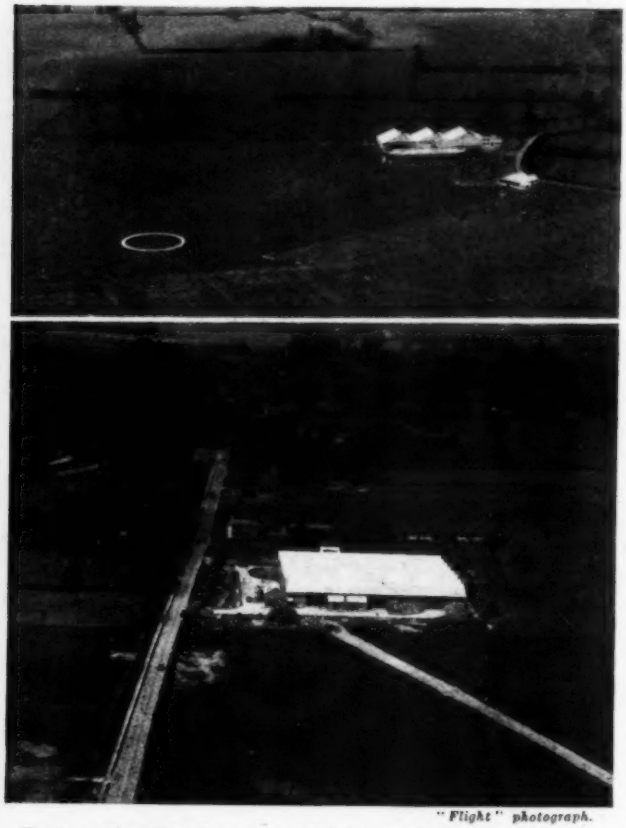
At 5,000ft. the rate of climb is 1,530ft./min.; at 10,000ft. 1,180ft./min.; at 15,000ft. 830ft./min.; and at 20,000ft. 500ft./min. The service ceiling (height at which rate of climb has dropped to 100ft./min.) is 26,000ft. approximately.

The economical cruising speed is 150 m.p.h., and the range in still air at that speed is 600 miles. With full load the take-off distance to clear a 50ft. obstacle is 230 yards, and the take-off run itself 165 yards. With brakes on the landing run is 200 yards, and the approach distance over a 50ft. obstacle to rest 330 yards.

Altogether, it can be said that the Westland Lysander is a remarkable machine.



Reynolds extrusions used in the Lysander. The smaller ones are used for window frames and similar purposes, while the central one is a main wing spar extrusion. Behind that are two standardised channels used extensively for making forked lugs. The extrusion on the right is used for the lift struts.



"Flight" photograph.

The two outward turning points, the factory at Buntingford (below), and the Barton buildings (above) of International Aircraft, Ltd.

KING'S CUP RACE

The Entry List : Turning Points from the Air

TWENTY-ONE entries have been received by the R.Ae.C. for the King's Cup Race on Saturday, July 2, which is being flown over a 50-mile circuit from Hatfield, with turning points at Buntingford, Herts, and Barton Airport, Beds. The entries, announced last week-end, are as follows:—

Entrant.	Pilot.	Aircraft.	Engine.
Viscountess Wakefield.	Capt. E. W. Percival.	Percival Mew Gull.	Gipsy Six
W. Humble ...	Entrant	Sparrowhawk...	Gipsy Major
S. K. Davies ..	Flt. Lt. H. T. Ferrand.	Percival Gull ...	Gipsy Six
I. I. Waddington..	C. F. Hughesdon	C.W.A. Cygnet	Gipsy Major
Maj. E. Howard ..	Wing Cdr. F. W. Stent.	Miles Monarch	Gipsy Major
S. T Lowe ..	Entrant	Comper Swift...	Gipsy III
F. C. J. Butler ..	Entrant	Percival Vega Gull	Gipsy Six
Mrs. J. Sherren ...	K. Waller ..	Percival Vega Gull.	Gipsy Six
Capt. W. L. Hope..	Entrant	Comper Swift...	Gipsy III
G. Guthrie ...	Entrant	Percival Mew Gull.	Gipsy Six
L. Fontes	Entrant	Miles Hawk ...	Gipsy Six
A. Henshaw ...	Entrant	Percival Mew Gull.	Gipsy Six
Viscount Wakefield	F/O. G. R. de Havilland.	T.K.2 ...	Gipsy Major
L. H. T. Cliff ...	Entrant	Miles Hawk Major.	Gipsy Major
E. G. Thompson ...	Capt. H. Broad ...	Parnall Heck..	Gipsy Six
Lieut. Gen. Sir Louis Vaughan.	J. A. C. Warren...	Parnall Heck ..	Gipsy Six
W. C. Devereux ...	—	D.H. Comet ..	Gipsy Six (Two).
Sqn. Ldr. E. C. T. Edwards	Entrant	Percival Gull ...	Cirrus Major
J. M. Barwick ...	Entrant	Miles Hawk Trainer.	Gipsy Major
Sir Derwent Hall... Caine.	T. M. Morton ..	B.A.4 ...	Two Gipsy Major.
C. H. Tutt ...	Entrant	Comper Swift...	Pobjoy Niagara III

THE O.U.A.S. ELEVENTH

THE Oxford University Air Squadron dinner—the eleventh annual forgathering of senior and junior members of the University and the Service—took place recently at the Headquarters of the Squadron at Manor Road, where the hard work of the staff had transformed the hangar into a dining hall gay with the Royal Air Force colours. The weather, in spite of the Meteorological Office, was sufficiently kind to allow the guests to assemble on the lawn as well as in the club-room, thus probably saving some of the two hundred and thirty persons present from elbowing their neighbours' sherry on to the carpet.

The Squadron was honoured by the attendance of the Vice-Chancellor of the University, Mr. A. D. Lindsay, the Master of Balliol, as well as by a most flattering number of Heads of Colleges. Air Marshal Sir William G. S. Mitchell was the principal Service guest, supported by many distinguished officers, among them A.V-M. P. H. L. Playfair, Air Officer Commanding No. 1 (Bomber) Group at Abingdon; A.V-M. O. T. Boyd (Director of Personal Services at the Air Ministry); Air Comdre. A. C. Wright; and two ex-Chief Instructors in Air Comdre. A. G. R. Garrod and Group Capt. C. N. Lowe. The two Chief Instructors of the rival squadrons of Cambridge and London, Wing Cdrs. Lockyer and Thompson, with representative contingents, were also present.

The Chief Instructor, Wing Cdr. F. L. B. Hebbert, proposing the toast of "The Guests," said that it was his maiden speech at the Squadron's dinners and pleaded the First Offenders' Act for any shortcomings, but committed no first offence. He stressed the importance of occasions such as this annual dinner for their corporate effect on the life of an organisation such as the University Air Squadron, which was a fluid body with a semi-permanent nucleus and subject to the varying gravitational pulls of the University constellation. He welcomed the presence of the Vice-Chancellor and other senior members of the University as showing their appreciation of the Squadron's importance among the activities of University life. He was also particularly pleased that Sir William Mitchell had been able to break away from the obviously heavy burden of Air Council work to attend the dinner and make a speech. As to the members of the Squadron, he welcomed the instinct which had made them join it. It was up to the members to maintain the standard of the Squadron, and enhance it if possible. In conclusion he hoped that the guests present would remain friends of the Squadron for many years to come.

Air Marshal Sir William Mitchell replied for the guests in a short but humorous speech. He expressed his regret that Lord Winterton had been unable to attend, and his own pleasure at having the chance of meeting so many senior members of the University. He referred favourably and hopefully to the numbers coming forward for the R.A.F. and Volunteer Reserve, and congratulated the Squadron on the fact that it had achieved a record number of flying hours during the previous term.

The Vice-Chancellor, Mr. A. D. Lindsay, then rose to propose the toast of the Squadron. He welcomed the Squadron, he said, as being the necessary blending of those disparate entities, the University and the Services. The University was, in general, inclined to dislike a discipline which limited the individual's freedom of thought, a limitation to which, he thought, the Services were prone, to judge by his experiences of 20 years ago. Bodies such as the University Air Squadrons, however, managed to bring together divergent points of view and to produce a successful compromise.

Mr. W. N. Monteith (Magdalen College), the senior member of the Squadron, replied. After a quite unnecessarily modest opening, in which he lamented the fate which had brought him to his feet, he went on to express the views, as he saw them, of the undergraduate members. The Squadron had been founded as a non-military body for the purpose of promoting co-operation between the University and the R.A.F. And in this it had been remarkably successful. As a proof of this success, he pointed to the fact that, of 189 past members whose activities were known, 161 had joined the R.A.F. or some form of the Reserve.

That was in a peaceful period, and now, though he did not propose to discuss the state of Europe, he would say that they all felt that times had changed. Throughout the Squadron there was a strong feeling that, in the words of an "intellectual" speaking recently at the Union Debating Society, they wanted to be "not only prepared, but ready." In short, it seemed that the time had come to recognise the Squadron as a military institution. That being so, he appealed for the equipment of the Squadron with Service types of aircraft, for the introduction of further training, and for facilities for more flying. He ended with a humorous but graceful tribute to the Squadron's flying instructors.

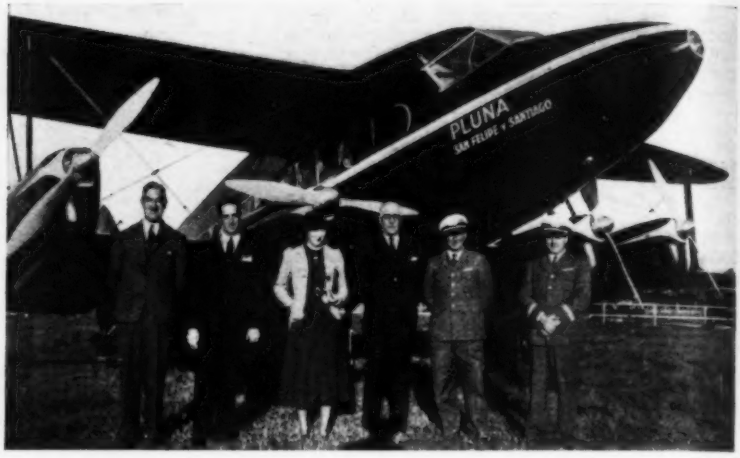
BRITISH CORNER at the BELGRADE SHOW

Nothing bold to strike the eye, but plenty of sound detail—the British collective exhibit, which included Rolls-Royce, Bristol, De Havilland, Dunlop, High-Duty Alloys, Simmonds Aerocessories, and Smith's Aircraft Instruments. The Show is reviewed on page 561.

COMMERCIAL AVIATION

THE WEEK AT CROYDON

"A. Viator's" Weekly Causerie on Airline Affairs at London's Terminal and Elsewhere



PROVEN: After a year of successful operation with two D.H. Dragonflies, P.L.U.N.A., Uraguay's first airline, took delivery of a D.H. 86B, which has now been carrying full passenger loads for four months. The machine is seen here with some notabilities—Mr. Ballantyne, D.H. manager in South America; Sr. Alberto Marquez Vaeza; Sta. Fleurquin; Dr. Fleurquin, a director of P.L.U.N.A.; Capt. Noack, chief pilot; and Capt. Nudelmann, pilot.

LAST week's gale, which created such consternation in shipping circles, had practically no effect on air travel. A passenger who crossed from the Continent when the storm was at its height told me that it was a remarkable experience to sit in an aeroplane so steady that a brimming coffee cup did not spill a drop while one looked down at Channel boats standing on their heads.

Some years back we used to parody Mr. Jarrocks, saying "Take not out your planes on a werry windy day," but the other "werry windy" afternoon I returned from the Continent behind one of the very old hands in the airline business. He kept well above the bump zone until the English coast and then gradually descended through clouds in a long slant, which brought us over Croydon at exactly the right height at which to commence the landing circuit.

Of course, we had a bump or two getting through the clouds, but not more than the sway of a train rounding a curve, so far as discomfort was concerned. Now this is very remarkable, when you remember that five or eight years back shipping and air people made common cause of the regrettable point that neither on the sea nor in the air should we ever be rid of the risk of travel sickness.

Sabena had a bit of bad luck last week when one of their old tri-motor Fokkers (now used exclusively for freight and almost exclusively for bullion) was returning empty to Brussels and sat down a trifle suddenly on the doorstep of a chapel in Kent. The pilots walked right into a ladies' tea-party in the back premises where, it is understood, they were regaled with plum cake and large cups of tea.

Beautiful but Dumb

Considerable excitement was caused at Croydon one day last week, when it was observed that "one mannequin" was manifested as part of the inward cargo of a Paris-London plane. Stories of a beauteous American girl who covered herself with stamps and had herself posted as air mail in the States were remembered, though you can't do that there 'ere, according to G.P.O. regulations; and, anyway, where do the officials stamp such a parcel with the necessary post marks?

Anyway, the machine duly arrived from Paris and it looked for a moment as if the lady had swooned, for she was carried across the tarmac by an embarrassed official. Later (after artificial respiration had been tried) it was discovered that the mannequin was made of wax, and if you go to one of the big London stores, she is the third from the left with the green eyes and hair to match, displaying the latest in beach costume—which does not amount to much.

Zurich seems to be the fashionable resort for the younger set at the moment. Last Thursday Miss Imogen Baguley flew there, quite unchaperoned, by Imperial Airways. She is five years old. Not to be outdone, the Misses Jean (4½) and Barbara (17 months) Rudd set off for Zurich on Sunday. Barbara, whose first flight it was, travelled in the care of Jean, who had done that sort of thing three or four times and had her own passport, anyway, when she was three.

British Airways, I hear, have quite settled in at Heston and had heavy traffic over the holidays. A few of their travellers arrived vaguely at Croydon and brought grist to other people's mills, but I doubt if B. A. missed them, being so busy and all.

Very disconcerting, all this moving to and fro. One wily B. A. official, who schemed to live off the Croydon-Continent route, now finds himself right under every one of his company's arriving and departing planes. He has developed amazing theories about the inadvisability of night flying. If you haven't heard an Electra, that may not convey much to you; still, as I have said before, they are nicely quiet for the people inside them.

Generous Tribute

The Editor of an American aviation journal recently paid a handsome tribute to Imperial Airways after a trip to New York-Bermuda by Pan-American and a return flight by Imperial Airways *Cavalier*. He said, "We have been at the receiving end of a lot of subtle insinuations that the British were behind in commercial aviation, but we can say with all candour that one of the greatest experiences in flying scheduled air transport lines was the New York-bound flight in *Cavalier* . . . there is nothing in the United States like *Cavalier*. If we look at the Bermuda service alone, Imperial Airways is four or five years ahead of Pan-American Airways."

Everyone knows the Imperial Airways' boats are second to none, but it takes real honesty on the part of the "opposite number" to say it so frankly.

The American attitude in this matter may be commended to certain narky souls we all know, who can never find a decent word to say of foreign aircraft and aviation. When a foreigner does a good show their silence is such that the dropping of a box of pins sounds like massed bands; but when the foreigner has bad luck, their howls are such that you wouldn't hear a ton of bombs drop.

VENETIAN VENTURE

Avio Linee Inaugurates London-Venice Service with Fiat G.18-V

THE assortment of transport aircraft using Croydon has lately been supplemented by the business-like low-wing Fiat G.18, used by Avio Linee Italiane S.A. for its new London-Venice route. The first official flight was made from this country last Wednesday, though a year ago the Paris-Venice connection was introduced with encouraging results. Scheduled times are: Depart Croydon 8.45 a.m., arrive Paris 10 a.m.; depart Paris 10.30 a.m., arrive Turin 1.15 p.m.; depart Turin 1.45 p.m., arrive Milan 2.20 p.m.; depart Milan 2.30 p.m., arrive Venice 3.35 p.m. The initial trip enabled us to get in a leisurely sun bathe and swim from the Excelsior Hotel on the Lido, having left Croydon at the gentlemanly hour of 8.45 a.m.

The Alps are cleared at about 15,500ft., the built-in oxygen system proving a very definite boon. Delivery is through individual leads and regulators from a set of cylinders in the extreme nose of the fuselage. Carefully studied heating and soundproofing (the latter by Dr. Zand, of Sperrys) keep things happy.

The pilots give the G.18-V very high marks, enthusing particularly over its behaviour under ice-forming conditions. The machine is virtually the "speed model" of the G.18, also employed by Avio Linee. The company has six G.18-Vs and four G.18s with Fiat-built Hornets. One of the latter, incidentally, took over at Milan.

The essential difference between the two models is that the "V" type is powered with two fully supercharged Fiat A.80 R.C. eighteen-cylinder radials giving 1,000 h.p. each at 13,500ft. This is the first "eighteen" to go into production; the weight is 1,600 lb.. They are geared 5:8, and drive Fiat-Hamilton c.s. airscrews. The cowlings are of the long-chord Magni variety and starting is effected by a Garelli compressed-air system. No fuselage fuel tanks are fitted (there are eight in the wings, sufficing for a range of 1,025 miles) but smoking is not permitted.

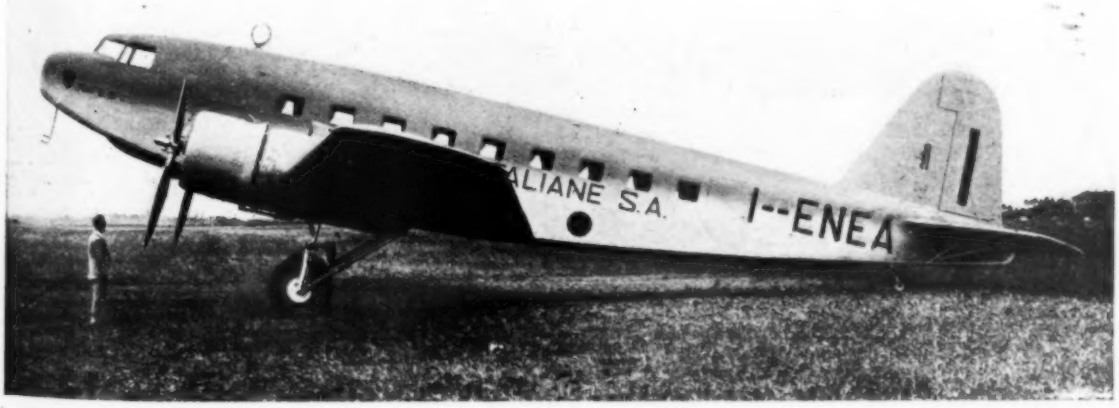
Three-spar wing construction is employed, the wing covering being both smooth metal and fabric. Chrome molybdenum steel tubing is used for the centre section.

The fuselage is flat-bottomed and slab-sided and is divided into a compartment for two pilots and a wireless operator; the passenger cabin (normally with eighteen seats); the toilet, and a luggage compartment extending almost to the tail. We sounded Signor Gabrielli, the designer, on the design of the fuselage; he referred to N.A.C.A. recommendations relating to the liigh aerodynamic efficiency and said that the particular shape adopted shows up well in obviating tail buffeting.

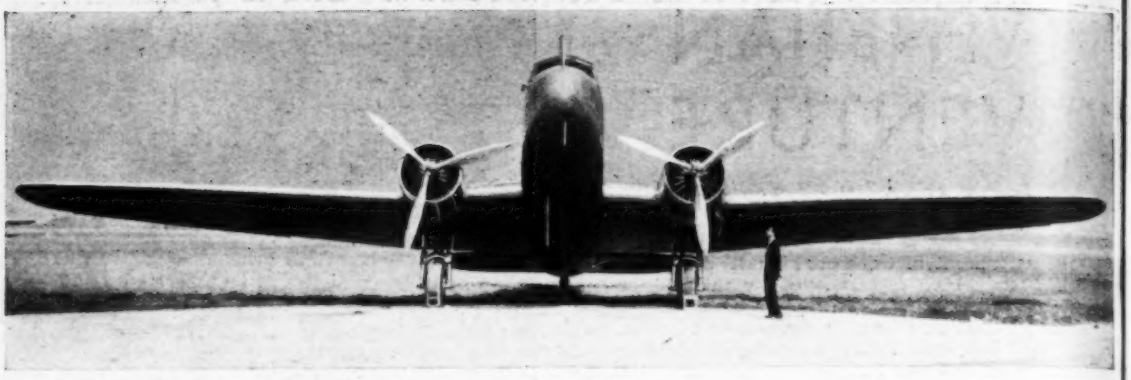
The eighteen-seater cabin of the G.18-V used on the London-Venice route by Avio Linee.

Signor Gabrielli, by the way, is very well known among the technical fraternity in this country and is responsible for the design of the Fiat G.50 monoplane fighter now in large-scale production for the Regia Aeronautica. He is firmly of the belief that high wings for transports are highly over-rated, because after the initial thrill of flying a passenger usually goes to sleep or produces a book. Commercial considerations permitting, he would like to design a mid-wing transport.

To return to the trip: the Turin-Milan section offers a



The somewhat unusual fuselage shape of the G.18-V is apparent here. Although the bottom and sides are flat, the top speed is about 250 m.p.h. with two eighteen-cylinder Fiat radials of 1,000 h.p. each.



As on other current Fiat types the inboard sections of the wing of the G. 18-V are thickened.

grand view of the flat plain of Northern Italy. The fields are apparently cultivated to the limit and have been flooded to compensate for a drought. The Fiat cuts across the southern end of the magnificent Lake Garda, where the Italians have conducted the bulk of their research with high-speed seaplanes. Approaching Venice the vista of the seascape set one musing as to what interpretation of the scene Turner would have given. The San Nicolo aerodrome is small and narrow and our approach caused us to cut low across the bows of a cargo steamer. We were somewhat amazed (it being our first visit) at the bulk of shipping, but even more so at the variety of large transport machines on the aerodrome. We spotted among others a Ju. 52, an Electra, a Savoia S.73 and one of the handsome new Savoia S.75s.

On the return trip we were joined some way inland by a pair of Fiat C.R.32 fighters which, we gathered from our second pilot, were from Ghedi aerodrome. They became embarrassingly playful and it was probably as well that most of our fellow passengers were dozing.

The Alpine crossing was made under the most perfect conditions. Our radio operator beckoned us up front into the sanctum of our sociable pilots, Lotti and Guido, so that we might derive the utmost pleasure. We had barely settled back in our seats when our wings began to rock quite sharply. Looking ahead we saw the reason; we were greeting a grey sister ship which we passed at a relative speed of nearly 400 m.p.h.

We had about 45 minutes for lunch at Le Bourget, where there is usually something worth looking at. On the outward run it was the King's Envoy, doubtless on business relative to the impending visit of Their Majesties; this time it was a camouflaged L.A.P.E. Douglas from Spain.

One finished the trip with the conviction that Avio Linee is an up-and-coming line. Plans for expansion include the ordering of seven Fiats with four eighteen-cylinder radials of about 1,300 h.p. each. Some of these are likely to be put on the Abysinnian route and others may be used for the lucrative Turin-Rome service.

The present fleet of the company is: Six Fiat G.18-Vs; four Fiat G.18s; six Savoia Marchetti S.M.73s; one Douglas D.C.2; and one Fiat A.P.R.2.

Atlantic Clipper Emerges

THE 74-passenger Boeing Atlantic Clipper, which has four 1,500 h.p. Cyclone engines and a wing span of 152ft., was launched from its makers' works on the Duwamish River at Seattle last Wednesday.

It was to have made taxi-ing and flying tests forthwith, but, it is stated, trouble was experienced with sparking plugs and the tests had to be deferred.

Still More Factories

IT is reported that Rolls-Royce, Ltd., are to erect a fifty-acre aero engine factory at Crewe, and to employ over 4,000 men there. The proposed site is near Merrill's Bridge, at the west end of the town.

Meanwhile, it appears that negotiations for the land required for Lord Nuffield's aero engine factory near Birmingham are going through successfully.

British Mission Returns

MEMBERS of the British Air Mission to Canada and America returned to Southampton on Tuesday of last week in the *Queen Mary*. The result of their investigations were placed before the Secretary of State for Air the next day. The members of the commission, which had left this country a month previously, were Air Comdre. A. T. Harris, Air Comdre. J. G. Weir, Sqn. Ldr. (Cdr. R.N.) Caspar John, Sqn. Ldr. C. E. Horrex, and Mr. F. Rowarth.

Aalborg's Airport

ABOUT 70,000 spectators witnessed the festival opening of Denmark's newest airport at Rodslet, near Aalborg, on April 29. The opening ceremony was performed by Mr. Fisker, Minister of Public Works, and addresses were delivered by Mr. Aagee Jorgensen, Mayor of Aalborg, and Mr. Gunnar Larsen, speaking on behalf of D.D.L. An international air meeting was arranged in connection with the opening of Rodslet, in which about seventy different machines participated.

The chief attraction was the new Focke Wulf Condor recently acquired by the D.D.L. It was flown by Count von Schack, who gave a rather startling demonstration of the manœuvrability of this big transport by looping the machine over the heads of the spectators—who mistook Count Schack's aerobatics for the initial stages of a catastrophe.

Learning at Leamington

SOME ninety members of the Coventry branch of the R.Ae.S. recently visited the Leamington Spa works of the Automotive Products Co., where they saw Lockheed undercarriage and brake equipment in production.

Moulding Transparent Sheet

WELL known as manufacturers of precision gauges and allied equipment, as well as the Mollart ball-joint, the Mollart Engineering Co., Ltd., of Kingston By-pass, Surbiton, Surrey, have now branched out in a new direction.

They have inaugurated a section in which all classes of moulding work on transparent materials—*e.g.*, for windscreens, windows, gun turrets, etc.—are being undertaken.

The new division is under the management of Mr. F. W. Smith, who has had long managerial experience with some leading optical concerns, and was at one time with Vickers at Sheffield. He has been appointed to the Mollart board.

H.R.A. Airscrews

WORK has started at the new factory of Hordern-Richmond Aircraft, Ltd., at Chesham, Bucks, on airscrews, a branch in which the firm intends to specialise. On the technical side they are well qualified for such work, as Mr. A. A. D. Lang is on the board of directors and Mr. "Tony" Fletcher is chief designer. The Duke of Richmond and Gordon is chairman, and other directors are Capt. H. S. Kevill-Davies and Mr. E. G. Hordern.

In addition to normal wooden airscrews the firm will produce airscrews covered with the B.T.-H. protective covering, which has a matt finish and is not glass-hard, but from which, on the other hand, small dents disappear in an hour or so.

PRIVATE FLYING

Topics of the Day

False Values

NOWADAYS it seems that whenever a new machine is produced its sponsors invariably point with especial pride to its good behaviour at the stall. We are all rather inclined to overlook the fact that one or two of the very earliest light aeroplanes were at least as safe in this respect. In those days it was taken for granted that a machine, when stalled with the controls more or less in the central position, would sink on a level keel or, at the worst, drop its nose as the stall developed.

A few weeks ago I was flying a trainer which may be considered as the direct descendant of the first commercially successful light aeroplane, and this machine is certainly as safe, stable and controllable in the stalled or semi-stalled position as any machine of more modern design about which safety has been made a great talking point. Admittedly, the old Cirrus or Gipsy Moths spun with considerable *éclat* when forced to do so, but with the rudder central these machines would sit almost indefinitely at the stall at least without showing much sign of wing-dropping. Given a suitable undercarriage and reasonably calm conditions it would almost be possible to sink the old Moth in this attitude right into the ground, using, perhaps, a burst of engine over the last ten feet to reduce the sinking speed. And that is what we all claim for some modern types.

My only objection to the Moth tribe is concerned with the use of a spring for fore and aft trim adjustment. In the old days we were quite accustomed to the principle, but after flying various machines with proper screwjacks or tabs it seems to be rather barbarous to have to do battle with spring tension during the landing process. With tab adjustment the whole feel of the elevator while landing is, so to speak, the feel of the air itself, while a spring-loaded landing must necessarily be made almost entirely by ocular judgment.

Regrets

NEVER, it appears, shall we ever return to the ease of control of the old type of aeroplane. Designers can flap these modern aeroplanes to their hearts' content, but the pilot still cannot be given that perfect range of forced-landing adjustment which is possible with a good conventional biplane with strong sideslipping characteristics, and it is a particular pleasure to get back into a machine in which one feels that height can be lost immediately and which can be put down in any space large enough to permit a hundred yards or so of landing run. Probably the pilot who is trained on the new formula feels the very opposite. Initial bias is a bad thing.

Incidentally, there are always big variations in the handling qualities of braced biplanes, while cantilever monoplanes appear, at least to me, to be quite consistent in their characteristics. I know at least one club where there are five identical training types, but not one of them feels exactly the same in the air. Two of them are almost cumbersome in aerobatics, while the other three are as light as one could wish.

Curiously enough, at least one of the two "heavies" tries to make up for it by being most unwilling to start spinning and will complete almost a whole stalled turn before starting into a spin. At the same time this machine also continues to spin for at least a quarter of a turn after the more normal examples has recovered. That, however, may be my imagination.

"*Flight*" photograph

QUICK CHANGE: Mr. A. R. Ward replaces the airscrew on the Chilton monoplane (see pp. 562—564) at the Speke control during the Isle of Man air race. Meanwhile, Mr. Green of Stanavo tops up the tanks with four gallons—after the Chilton's 160 miles at full throttle. The other personalities are no doubt helping or hindering

Relativity

WHILE on the subject of aerobatics (for what they're worth) it always seems to me that people have got hold of the wrong end of the stick when they say, for instance, that, with modern fighters, there can be no dog-fighting in the ordinary sense. This is surely quite a relative matter. A dog-fight does not necessarily involve a number of machines manœuvring slowly in a small space; it can equally well involve a number of machines manœuvring quickly in a very large space.

If eighteen pilots are all flying 300 m.p.h. machines the relative effect to them is exactly as if they were flying 100 m.p.h. machines, and the air will appear to be just as crowded. The battle, however, will cover a considerable space in cubic miles and there will obviously be limitations in the kind of aerobatics which may safely be indulged in between ground level and 20,000ft. Unfortunately, useful space in a vertical plane is not unlimited and sheer speed will undoubtedly mean new methods.

Not long ago I was carrying out mild aerobatics on a trainer which was fast in comparison with those which I had previously handled. There was, in normal circumstances, no obviously greater tendency to black out. My loops involved thousands instead of hundreds of feet and my steep turns had a radius of thousands rather than hundreds of yards.

The point seems to me to be that, with so much reserve speed and stronger aeroplanes with more powerful controls, it is possible but not by any means essential to suffer personal discomfort. With plenty of space a loop at 300 m.p.h. needs to be no more "geeful" than one made at 100 m.p.h. Presumably, however, the winners in any future air battle will be those who can stand the greatest supply of this "g" while flying aeroplanes which are strong enough to take whatever the pilot himself can stand. You could black yourself out quite satisfactorily in a Cirrus I Moth, but the necessary manœuvre was rather hard on the machine.

INDICATOR.

Private Flying

FROM the CLUBS and SCHOOLS

SOUTH COAST

THE South Coast Flying Club put in 33 hours' flying last week, and Mr. W. Kennedy qualified for his "A" licence. A trip to Hurstpierpoint in connection with a demonstration of the A.R.P. was made by Mr. Pashley. The club is making an endeavour to obtain a bathing hut for the use of members during the summer.

LONDON

With a first solo flight by Mr. E. B. Cunning and the completion of "A" licence tests by Mr. T. Phelan, a flying total of 55 hours was logged for the week ended June 4.

MARSHALL'S

Cross-countries to Lowestoft, Tollerton, Oxford and Hanworth were included in the flying total of 58 hours put up by Marshall's Flying School last week. Four new members joined.

STRATHTAY

At Scone flying has been rather restricted recently owing to high winds and rain. During May a total of 110 hours was flown, but so far this month a drop has been experienced. Mr. Alan Sharpe, of Lochearnhead, is a new member.

BORDER

Adverse weather has prevented practically all flying during the past week and there is very little of interest to report from Carlisle. Members of the Border Flying Club operated the St. Bee's turning point for the London-Isle of Man Air Race.

HAMPSHIRE

Due to unusually high wind during the week ended June 3 only 35 hr. 50 min. was flown, but Sub. Lt. Leggatt managed his first solo. Mr. G. H. Jackson took off in his Fox Moth for New Guinea on June 2. He is accompanied by Mr. Clive Bayley as far as Dum Dum.

READING

The arrival competition held last Sunday was won by Mr. L. E. Rushton, of Blackburn. Many club members gathered for the demonstration of machines and Messrs. Skinner, Dalrymple and Eugster put up a good show. Ten new flying members have joined the club.

SOUTHEND

The flying times for the last two weeks have been lower than of late owing to high winds. The month of May held the record for dual, and the solo total was a "near-record." The week-end was busy and included cross-country flights to Hull, Northampton and Norwich.

YORKSHIRE

For the week ended June 3 a total of 80 hr. 55 min. flying was done and for the month of May further total of 281 hr. 50 min. was logged. Trips were made to Worcester, Torquay and Acklington, and the aerodrome was well attended on Empire Air Day in spite of the bad weather.

HANWORTH

Of three members of the London Air Park Flying Club in the Isle of Man Race one, Mr. S. T. Lowe, took first place. Flying activities have been hampered by the high winds, though Mr. De Ritter (Midland Bank Flying Club) made his first solo and Miss E. A. Robertson completed her "A" licence tests. A total of 60 hr. 55 min. was returned for the week ended June 4.

C.A.S.C.

There being no official flying over the Whitsun holidays very little was done by members at Cambridge, although a few spent the week-end at the aerodrome. On June 12 an Open Day is being held, the programme for which includes an arrival competition between 14.00 and 14.45 hours, open to all.

BARTON (BEDS)

The first summer dance of the Bedford School of Flying was held on June 2, when 120 members and guests attended. The guest of honour was Miss Amy Johnson. Members are now looking forward to the Dawn Patrol to be held on June 12. Mr. A. C. Kelway completed his "A" licence tests.

NOTTINGHAM

Two social events to be held shortly are an At Home, fixed for Sunday, June 12, and the inter-club competition for the *Nottingham Journal* Flying Trophy, to take place on the same day. The programme will include an aerobatic display and various types of aircraft will be on view. The flying total amounted to 78 hours during May.

BOURNEMOUTH

The Bournemouth Flying Club, with a fine day and a good flying programme, assisted in the success of the aerodrome's Empire Air Day display. Crazy flying was demonstrated by the club instructor in the new Avro Mongoose, and the substantial cheque sent to the Air League Benevolent Fund was proof positive of the reception of the display.

BROOKLANDS

Bookings for the trip to the Empire Exhibition at Glasgow on July 4 and 5 are going ahead, and likewise for the Afternoon Patrol on June 18. Pilots of machines for the arrival competition are impressed that they must land by 3.20, when the programme is due to commence. During Whitsun flying times were low owing to high winds and the effect of the holiday.

CINQUE PORTS

Members were, generally speaking, undeterred by the weather last week. One flew to Paris and another to Cannes, while Mrs. Morris Davies and Mrs. Macdonald arrived back from their flying holiday in France. Mr. and Mrs. Fred Miles called in at the club on their way to the South of France in the new Miles Monarch. The flying for the week totalled 40 hours, and Mr R. Lilburn passed his "A" licence tests

HERTS AND ESSEX

Considerable rain during the past fortnight has reduced flying to 119 hours; for May a total of 282 hr. 17 min. was returned. A competition for junior pilots involving a map-reading test is to be held on Sunday. The results of the "Janet Lady Brickwood Challenge Cup" competition, held on May 22, were given in *Flight* of May 26. The third place, it appears, was taken by Mr. L. F. P. Walters, and not by Mr. F. Morat. There were seventeen entrants.

BRISTOL AND WESSEX

The programme for the annual garden party on June 11 is now complete and includes an aircraft arrival competition between 2.30 p.m. and 3.30 p.m. with prizes of £10 (first) and £5 (second); a car arrival competition between 2.45 p.m. and 3.30 p.m.; affiliation exercises by No. 501 (County of Gloucester) Bomber and No. 17 (Fighter) Squadrons; demonstrations of light aircraft; a clay pigeon shoot; a demonstration of petrol-driven model aircraft; and a sherry party at the clubhouse at 6.30 p.m.

South London Soaring

THE London Gliding Club was fortunate in its discovery of a soaring site to the south of London, to be used as an auxiliary to Dunstable. Colley Hill, near Reigate, is the venue, and it is hoped that a branch of the Club may be established there. Certainly it will be of the greatest interest to would-be members who, living to the south and west, find Dunstable too far distant.

The new site, which was exhaustively tested by a dozen-odd people with winch-launching in various types of sailplane during the Whitsun holiday, is on the Buckland Court estate of Mr. Robert Sanders, just to the north of Buckland village on the Reigate-Dorking road. While the launching-area as compared with Dunstable is limited, the long ridge of the North Downs, broken by various buffs, ensures an excellent "beat" with any wind from E.S.E. to W.S.W.

Some extraordinarily good long-distance performances were put up from Colley Hill during the holiday. Mrs. Joan Price, in a Rhonbussard, crossed London and eventually reached Frinton, on the East Coast, a straight-line distance of 76 miles. She also reached a height of 6,000ft. Mr. I. Pasold, in a similar machine, reached Colchester (65 miles), and Mr. J. S. Fox, in a Rhonadler, achieved Farnborough (27 miles). Mr. D. Greig, in a Kirby Kite, visited Croydon at a height of 5,600ft. and all but succeeded in returning to Colley Hill.

Congratulations to Miss Ann Edmonds, who, with Mrs. Price, discovered the site and who acted as hostess last week-end to a number of inquiring visitors.

Meanwhile, from Dunstable, Mr. Lionel Wills had achieved a British height record of some 11,000ft. At this rate we shall be hearing of stratospheric sailplanes.

The Luton Accident

FLIGHT greatly regrets to record the death, in an accident at Luton on Wednesday of last week, of three well-known members of the Redhill Club.

The victims were Sir Alasdair McRobert, Mr. R. E. L. Beere, and Mr. E. S. Baker. Sir Alasdair, who was managing director of the Indian Aviation Development Company and chairman of the British India Corporation, had recently returned from a tour of India in his Vega Gull. He was believed to have been piloting the machine at the time of the accident, the cause of which is unknown at the time of writing.

Mr. Beere, who had recently joined the Red Hand Compositions Co. as aviation manager, formerly occupied a similar post with the Cities Service Oil Co. He was part-owner of a B.A. Swallow with the third victim, Mr. Baker.

MODELS

A Successful Pusher

By M. R. KNIGHT

THE pusher layout is a tough proposition from the model designer's point of view, for it is none too easy to secure adequate rigidity without serious weight increase, while the difficulty of achieving even a modest flight duration from so restricted a motor length is considerable. Mr. C. A. Rippon, of the Northern Heights M.F.C., is therefore to be congratulated on a duration of 40sec. with his "Pusher Pup," obtained with a single skein of rubber.

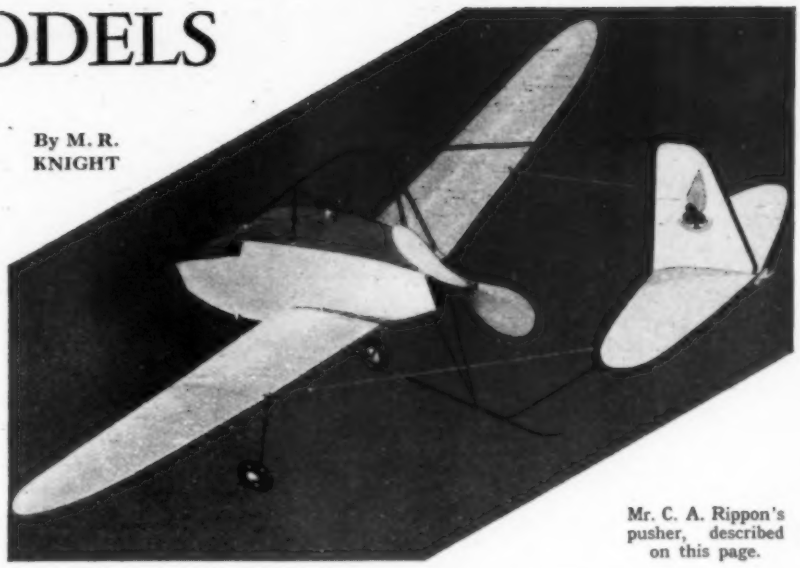
One would like to see the tail carried on hollow booms emerging from the wings, as in modern full-scale practice, but the designer's long experience with pusher models has convinced him that in model sizes this leads to wing distortion. The system adopted in the "Pup" has proved entirely satisfactory. This consists of two bamboo outriggers springing respectively from the cabin roof and from the underside of the nose, braced to the fuselage with two pairs of vee-struts, and terminating in a built-in fin, 5in. high, in which is concealed a trimming weight. The tailplane, which has a span of 10in., and a root chord of 3½in., is in two parts, plugging together through the fin-base by means of two bamboo prongs in paper tubes. Two threads, tensioned with rubber bands, brace the tail-plane to the wings. The arrangement will be clear from the photograph.

Each half of the wing has a span of 15in., and the chord is reduced from 4¾in. to 3¾in. by sweeping back the leading edge. It consists of balsa leading edge, middle spar, and ribs, birch tips and trailing edge, and two bamboo prongs which plug into paper tubes within the fuselage. The section is Clark Y, and the dihedral angle 10 degrees.

The rectangular fuselage is 13½in. long, 3⅜in. deep, and 2½in. wide. A detachable undercarriage is fitted, consisting of two bamboo struts, carrying 1½in. plastic wheels, and sprung by rubber bands passing through paper tubes. The wheel-track is 8in. A free-wheeling airscrew, 9in. in diameter and 11in. in pitch, is turned by an 18in. motor consisting of 6 strands of $\frac{3}{16}$in. flat rubber, plaited for tensioning so that the unwound skein cannot upset the trim.

Taking the thrust-line as the datum, the wings are set at 3 degrees positive incidence, while the tailplane, which has a slightly lifting section, has its chord-line coincident with the datum-line. Torque is counteracted by offsetting the airscrew shaft. The tip-to-tip span is 32½in., the length 25½in., and the weight 3½ oz.

A more elaborate pusher on "Orone" lines, and with a flexible airscrew drive, is now under construction.



Mr. C. A. Rippon's pusher, described on this page.

"Bringing the Sea to the Seaplane"

UNDER this heading there appeared in *Flight* of July 2, 1936, a photograph of The Model Aircraft Club's recently introduced canvas launching-tank for seaplanes, devised by Mr. H. Fialko. This contrivance obviated the various factors formerly militating against seaplane popularity.

Recent improvements to the tank have included lengthening to 20ft., tapering the width from 4ft. to 6ft., and increasing the depth to 4in., the latter removing any lingering suspicion of models "sitting pretty" on the tank floor instead of floating. The capacity is now 200 gallons. The only remaining difficulty would appear to be change of wind direction after pegging-out of the tank, though some pond enthusiasts have criticised the lack of ripples.

The use of tanks in an S.M.A.E. contest was permitted for the first time on May 22, when seaplane enthusiasts competed for a handsome trophy presented by Short Bros. The winner was Mr. A. Tyndall (Lancs M.A.S.), who averaged 194sec. on three flights, though whether he made use of tank or pond is not known. But second and third places went to members of "the tank corps," Messrs. J. Worden and G. J. Liggitt, both of The Model Aircraft Club, averaging respectively 168sec. and 135sec. At Wimbledon no fewer than five flights exceeded the existing seaplane record, and a claim of 222sec. has been submitted to the S.M.A.E. by Mr. W. Worden.

Models in Denmark

THE chairman of the Dansk Modelflyver Forbund (Union of Danish Model Pilots), Mr. Per Wishaupt, writes to correct the statement made by Mr. J. C. Smith, in lecturing to the Women's Engineering Society (reported in *Flight* of April 7), to the effect that the Danish Government is sponsoring model aviation in that country. Accurate information of happenings abroad is not easily obtained, and Mr. Smith agrees that he was misinformed.

The letter gives the following information. Although 30 years old, model flying in Denmark was moribund until 1934, when activity was stimulated by the publication of Mr. Flensted Jensen's *Model Flyvning*. A club was started in 1935, and there are now twenty. The Dansk Modelflyver Forbund was started in 1937.

About 60 per cent. of the models are gliders based on German designs, and a type record of 35min. was recently established with a Winkler by Mr. Ole Holten. Rubber-

Though this page is normally confined to flying models, we feel that this non-flying scale model of a Blackburn Shark is of such exceptional merit that it deserves a place. It was built to a scale of ½in. to 1ft. by Mr. J. R. Managh, of Winnipeg, working from *Flight* drawings and photographs of the original.

driven models on German and Swedish lines are slowly gaining favour, but flying scale and petro models, and ultra-lightweights are almost unknown.

Coming Events

June 12: Weston Cup contest for Wakefield types, at Fairey's Great West Aerodrome. June 19, from 11 a.m. until dusk: "Northern Heights" Gala Meeting (programme giving details of popular contests obtainable for 4d. post paid from Mr. C. A. Rippon, 58, Hampden Way, Southgate, London, N.14), and S.M.A.E. contest for Women's Trophy presented by Mrs. A. P. Thurston, both at Fairey's. June 26: S.M.A.E. seaplane contest for Lady Shelley Cup, S.M.A.E. flying-boat contest for White Cup, and N. Kent Model Aircraft Society's open flying-boat contest for Roberts Trophy, all at Danson Park, Welling. July 3: the team of 6 to represent Great Britain in the Wakefield contest will be chosen in eliminating trials at Fairey's.

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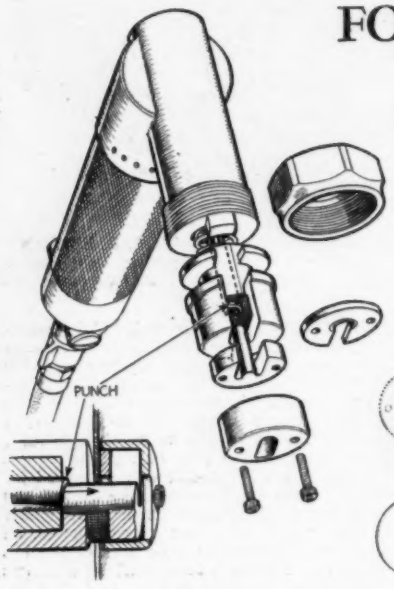
In their latest *Premier Guide*, Premier Aeromodel Supplies, 2a, Hornsey Rise, London, N.19, combine a price list with much sound advice on model construction. Several new designs are offered in the form of blue-prints and kits of materials.

FOR SPEEDY SHEET-CUTTING



Details of the Desoutter nibbler

AN unusually interesting production tool is announced. Desoutter Bros., Ltd., The Hyde, Hendon, are in production with a portable pneumatic nibbler that weighs 2 lb. only, and will cut up to 18-gauge duralumin and 20-gauge steel at 10ft. per minute. In the past, it is claimed, the only nibbling machines available have been large power-driven tools taking up a lot of floor space and usable only when the work could be taken to the tool.

This tool—which looks so simple yet has taken twelve months' hard work to perfect—was actually developed for service and repair work in the field of metal-skinned aircraft. Because of its extremely compact design it can start cutting anywhere in a sheet of any size or shape by introducing the head through a 1in. hole. Thus it could be used to cut out a damaged section of a leading edge in position, to cut holes for a petrol-tank filler, or to cut out inspection holes.

The secret of the Desoutter nibbler is the design of the punch and the neck-frame joining the die-holder to the body of the tool. Patents have been applied for to cover these points.

The punch is crescent-shaped, and takes 20 cuts to the inch. It is reciprocated by a vane-type pneumatic motor. Both punch and die are easily and cheaply replaceable.

Because this tool cuts by nibbling out a slot in the sheet, in which the neck-frame of the tool runs, the metal does not have to be parted (as in a shear), and so the nibbler cuts without any deformation of the sheet. Owing to the shape of the punch the "nibbles" overlap and thus produce an exceptionally smooth finish, without any burrs.

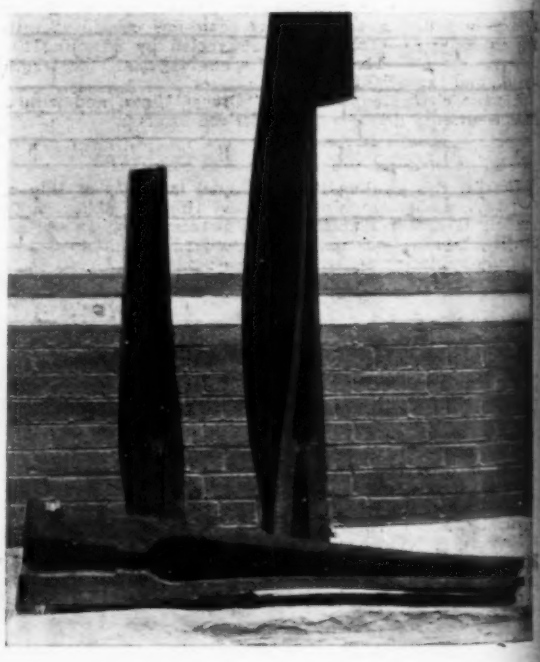
The nibbler can be used freehand, or to cut inside or outside a template. The minimum radius of cut is 1in. It can also be used with a simple and ingenious radius-arm attachment for cutting a truly circular hole from a centre. A ¼in. hole is drilled at the centre of the circle, and a 1in. hole anywhere between the centre and the circumference. The sliding pin on the radius arm goes into the ¼in. hole, and the head of the nibbler into the 1in. hole. The tool is started, and is made to cut outwards until the stop comes up against the sliding pin; thereafter the tool "walks" round the circumference of the circle. To hold the centre portion steady when the cut is nearly completed two little clamps are used across the nibbled slot.

CORD-BAKELITE AIRSCREW BLADES

THE development of solid and hollow airscrew blades of synthetic resin has been proceeding at the De Havilland airscrew factory at Edgware since 1936. Solid blades have been machined from the block, one of the more successful materials employed being Bakelite reinforced with special fabric. Interesting comparative experiments are also being carried out with woods compressed and impregnated with phenolic resin.

More recently, hollow blades have been moulded in Bakelite reinforced with cord. Sectionised examples were exhibited at the R.Ae.S. Wilbur Wright lecture (the concluding section of which is reported on pages 568e-568g of this issue).

An important feature is that the cords lie longitudinally, simulating very closely the grain flow in duralumin blades, particularly at the root flange where the blade is held against centrifugal load.

The material employed has a tensile strength of about 35,000 lb /sq. in. and a shear strength in the direction of the cords of about 6,000 lb./sq. in., while a shear strength approximately four times this value is obtained transversely to the cords such as across the root flange. High resistance to fatigue and high internal damping characteristics — noteworthy advantages for airscrew construction—are claimed. Relatively low weight is another advantage; the specific gravity is approximately one half that of duralumin. The Young's modulus figure is approximately 3.5×10^6 lb./sq. in.

At the present time the De Havilland Co. is developing a 5,000-size airscrew with corded Bakelite blades which is to be delivered to the Air Ministry for tests. In this project Bakelite, Ltd. (who, of course, are pioneers in plastics), are co-operating.